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STOKERS AND POKERS:

OR, THE

LONDON AND NORTH-WESTERN RAILWAY,

THE ELECTRIC TELEGRAPH,

AND

THE RAILWAY CLEARING-HOUSE.

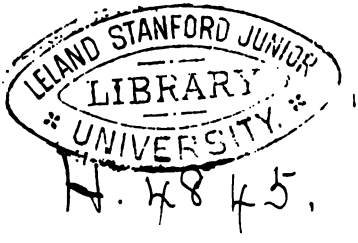
BY THE AUTHOR OF

'BUBBLES FROM THE BRUNNEN OF NASSAU.'

Head, Sir Francis Bond.

NEW EDITION.

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1861.



LONDON: PRINTED BY WILLIAM CLOWES AND SONS, STAMFORD STREET
AND CHARING CROSS.

TO

RAILWAY TRAVELLERS,

AND

TO THE PROPRIETORS

OF THE

GREAT WESTERN
MIDLAND,
LANCASHIRE AND YORKSHIRE,
YORK, NEWCASTLE, AND BERWICK,
EASTERN COUNTIES,
LONDON AND SOUTH-WESTERN,
YORK AND NORTH MIDLAND,
CALEDONIAN,
GREAT SOUTHERN AND WESTERN (IRISH),
LONDON AND NORTH-WESTERN,

AND

OTHER BRITISH RAILWAYS,

THESE ROUGH SKETCHES, DELINEATING THE DIFFICULTIES
ATTENDANT UPON THE CONSTRUCTION,
MAINTENANCE, AND WORKING OF A RAILWAY
ARE INSCRIBED.

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INTRODUCTION.

A GOOD many years ago, one of the toughest and hardest riders that ever crossed Leicestershire undertook to perform a feat which, just for the moment, attracted the general attention not only of the country but of the sporting world. His bet was, that, if he might choose his own turf, and if he might select as many thorough-bred horses as he liked, he would undertake to ride 200 miles in ten hours!!!

The newspapers of the day described exactly how "the Squire" was dressed—what he had been living on—how he looked—how, at the word "*Away!*" he started like an arrow from a bow—how gallantly Tranby, his favourite racer, stretched himself in his gallop—how, on arriving at his second horse, he vaulted from one saddle to another—how he then flew over the surface of the earth, if possible, faster than before—and how, to the astonishment and amidst the acclamations of thousands of spectators, he at last came in . . . a winner!

Now, if at this moment of his victory, while with dust and perspiration on his brow—his exhausted arms dangling just above the panting flanks of his horse, which his friends at each side of the bridle were slowly leading in triumph—a decrepit old woman had hobbled forward, and in the name of Science had

told the assembled multitude, that, before she became a skeleton, she and her husband would undertake, instead of 200 miles in ten hours, to go 500—that is to say, that, for every mile "the Squire" had just ridden, she and her old man would go two miles and a half—that she would moreover knit all the way, and that he should take his medicine every hour and read to her just as if they were at home; lastly, that they would undertake to perform their feat either in darkness or in daylight, in sunshine or in storm, "in thunder, lightning, or in rain;"—who, we ask, would have listened to the poor maniac?—and yet how wonderfully would her prediction have been now fulfilled! Nay, waggons of coals and heavy luggage now-a-days fly across Leicestershire faster and farther than Mr. Osbaldestone could go, notwithstanding his condition and that of all his horses.

When railways were first established, every living being gazed at a passing train with astonishment and fear: ploughmen held their breath; the loose horse galloped from it, and then, suddenly stopping, turned round, stared at it, and at last snorted aloud. But the "nine days' wonder" soon came to an end. As the train now flies through our verdant fields, the cattle grazing on each side do not even raise their heads to look at it; the timid sheep fears it no more than the wind; indeed, the hen-partridge, running with her brood along the embankment of a deep cutting, does not now even crouch as it passes close by her. It is the same with mankind. On entering a railway station, we merely mutter to a clerk in a box where we want to go—say "*How much?*"—see him horizontally poke a card into a little machine that pinches it—receive our ticket—take our place—read our newspaper—on reaching our terminus drive away perfectly careless of

all or of any one of the innumerable arrangements necessary for the astonishing luxury we have enjoyed.

On the practical working of a railway there is no book extant, nor any means open to the public of obtaining correct information on the subject.

Unwilling, therefore, to remain in this state of ignorance respecting the details of the greatest blessing which science has ever imparted to mankind, we determined to make a very short inspection of the practical machinery of one of our largest railways; and having, on application to the Secretary, as also to the Secretary of the Post-Office, been favoured with the slight authorities we required, without companion or attendant we effected our object; and although, under such circumstances, our unbiassed observations were necessarily superficial, we propose, first, to offer to our readers a faint outline of the difficulties attendant upon the construction and maintenance of a great railway, and then, by a few rough sketches, rapidly to pass in review some of the scenes illustrative of the practical working of the line, which we witnessed at the principal stations of the London and North-Western Railway—say EUSTON, CAMDEN, WOLVERTON, and CREWE.

LONDON AND NORTH-WESTERN RAILWAY.

CHAPTER I.

On the Construction of a Railway.

At the grand inauguration dinner eaten in Paris on the 28th of December, 1848, for the express purpose of celebrating the installation of the new President of the French Republic, it has been recorded by the reporters present, that among the numerous guests assembled, there was no one whose presence engrossed such universal attention as that of an erect emaciated member of "*La Vieille Garde.*"

The old soldier, it is stated, as he sat at table, scarcely noticed the constellations of bright, black, and hazel-coloured eyes that from all directions were concentrated upon him, but, addressing himself first to his own black bottle, and then with the utmost good humour to those of his neighbours, he drank and ate—drank—swigged—reflected,—and then, as if to refresh himself, drank again, again, and again, until, according to pre-arrangement, he stood up on the tribune to re-propose the health of "Louis Napoleon," to which—coupling the meteor now shining in its zenith with the "sun of Austerlitz," which, though sunk for ever below the horizon, still beamed as resplendently as ever within his heart—he added, with great naïveté, "Mais sans oublier l'autre!"

The French people, or rather the representatives of the French

nation who were assembled, had received the consecutive orations of several of the most illustrious of their fellow-citizens with considerable marks of approbation; but when the veteran in question, who was about seventy years of age, with hair white as snow, rose to address to them a short speech that would scarcely have filled his empty wine-glass, the sight of the uniform so dear to Frenchmen—the tall bear-skin cap, the crimson feather, blue coat, red facings, red worsted epaulettes, white breast, white breeches, long black gaiters reaching over the knee, and, above all, buttons with an eagle supporting the imperial crown—created a storm of applause which it would be utterly impossible to describe. For nearly a quarter of an hour shouts and clappings of hands prevented the old warrior from opening his lips, and the applause if possible increased when the veteran, with the palm of his hand turned outwards, stiffly saluted the company in correct martial style: and yet, strange to record, at the very moment of all this military enthusiasm, so characteristic of a nation of whom it was lately very eloquently stated "that it had been its ambition to be the world's guide and its destiny to be the world's warning," the French Government was not only without funds to protect public or private property, but, in fact, had nothing but the plunder of both to conciliate and feed the multitude of misguided and misguiding people who, by the ruin of commerce and by the stagnation of trade, were literally all over France starving from cold and hunger. Of their enthusiasm, therefore, as of that of the veteran standing up before them, it may truly be said or sung—

> "Happy 's the soldier that lives on his pay,
> And spends half-a-crown out of sixpence a-day!"

Having related, or rather merely repeated, this curious little anecdote, we will now endeavour to explain in what manner it applies to the subject of our chapter, namely, "*the construction of a railway.*"

It has been justly observed that "England is bound over to keep the peace by a national debt, or penalty, of 800 millions." During the glorious expenditure of all this money, the attention

of the country was solely engrossed with the art, employment, occupation, and victories of war. Our great statesmen were war-ministers—our great men were naval and military warriors of all ranks, whose noble bearing and gallant feats were joyfully announced, and, by universal acclamation, as gratefully rewarded; and if every man who took a government contract, or who in any way came into contact with government, easily made a large fortune by war, he, generally speaking, as rapidly spent it; and thus an artificial circulation of wealth was kept up, which, like the schoolboy's mode of warming himself, commonly called "beating the booby," produced a temporary glow, estimated at the moment to be of as much value as if it had naturally proceeded from the heart.

The English people during the period in question drank hard. The rule had scarcely an exception. As regularly as four o'clock P.M. struck, our noblemen, magistrates, judges, hunting squires, and country gentlemen, began to look a little flushed—the colour gradually increasing, until in due time they all became, like their sun in a fog, red in the face. Before bedtime the semi-rulers of the nation were half inebriated—some of our leading statesmen being, alas! notoriously, very nearly in the same state.

No sooner, however, were the British people, by the results of 1815, suddenly weaned from war, than their extraordinary natural powers, moral as well as physical, invigorated by comparative temperance, were directed to investigations, occupations, and studies which rapidly produced their own rewards. Indeed, without entering into details, the wealth which has been created and amassed since the period in question, added to that with which we have not only irrigated, but almost without metaphor top-dressed the greater portion of the old as well as of the new world, and, lastly, the extraordinary improvements that have taken place in light, heat, locomotion—electrical as well as by steam-power—machinery, in short in everything that administers to human comfort, form altogether the golden harvest of our labours; and thus, although to our eminent civil engineers considerable credit is due, they are, in fact, but secondary causes;

the engineer-in-chief—the primary inventor—the real constructor of our railways most indisputably being

THE GODDESS OF PEACE.

Send her victorious—happy and glorious—
Long to reign over us—God save that queen!

THE CONSTRUCTION OF THE LINE.

1. In considering the project of a railway, after fixing upon the two termini, it becomes necessary to select the towns through which it ought to pass.

2. When these have been determined, the chief engineer to whom the investigation of the proposed line has been confided, with the Ordnance map in his hand, walks and re-walks over the whole length (Mr. Robert Stephenson, in his investigation of the proposed line between London and Birmingham, walked upwards of twenty times over the country between each), until he feels that he carries in his mind its correct picture; and while he is thus imagining and making out various lines for consideration, his assistants are testing the eligibility of each by rapidly taking for him what are called "flying levels," as also "cross levels," along the principal ridges that at various angles intersect the proposed line, and yet, notwithstanding the accuracy of these mathematical precautions, it is almost invariably found that the eye of the chief engineer has intuitively selected the best line.

It is, however, as painful to reflect on, as it is humiliating to record, the prejudices, ignorance, passions, and artifice by which our principal engineers were opposed, or rather by which they were consecutively thwarted in the calm scientific investigations for the benefit of the public which we have just described.

Instead of a general desire on the part of the community to hail with gratitude, and to receive with open arms, an invention which was practically not only to enable them with double elbow-room, and at about half fares, to travel at four or five times the speed which by their utmost efforts they had previously been enabled to attain, but to afford similar facilities to millions of tons of manufactures and merchandize, much of which had

either been impeded by delay, or altogether clogged by the heavy charges on their transit, our engineers, in tracing the lines for our great arterial railways, were but too often looked upon as magicians, evil genii, or unclean spirits, whose unearthly object was to fright the land from its propriety.

In many instances where it was proposed, by tapping the dull stagnant population of a country town, to give vigour and animation to its system, the inhabitants actually fancied that their interests and their happiness would, like their habits, expire under the operation.

For example, it is well known that one of the results of Mr. R. Stephenson's deliberate investigations was, that the present London and North-Western Railway ought to pass through the healthy and handsome town of Northampton,—an arrangement which of course would instantaneously have given to it commercial importance of inestimable value. The inhabitants, however, urged and excited by men of influence and education, opposed the blessing with such barbarous force, that they succeeded, to their everlasting punishment, in distorting the line—*viâ* the Kilsby Tunnel, which, if the projected plan had been adopted, would not have been required—to a point five miles off! and if such ignorance could, in the nineteenth century, exist in a large and populous town, it cannot be a matter of surprise that our engineers should have had to encounter similar, or, if possible, still greater prejudices in rural districts.

It was there generally considered to be utterly incredible that a railway could ever possibly supersede our mail and stage coaches; at market meetings, and at market dinners, the invention was looked upon as, and declared to be, "a smoky substitute for canals;" and while men of property inveighed against its unsightly appearance, their tenants were equally opposed to the measure.

For instance, among the *reasons* for preventing the present London and North-Western Railway coming to Northampton, it was seriously urged by many very wealthy and respectable graziers in the neighbourhood, that the smoke of the passing

engines would seriously discolour the wool of their sheep; that the repeated progress through their verdant meadows of a sort of rumbling, hissing, fiery serpent, would, by continually alarming, fretting, and distracting the attention of their cattle, prevent them, "poor things!" from fattening; in short, such was the opposition to the new system, that one of the engineers employed by the London and North-Western Railway to trace out a branch line (which, at a considerable expense to the Company, was to confer inestimable advantages upon its locality) was attacked by the proprietors of the soil, and a conflict or battle royal ensued, which ended in very serious legal results.

3. As soon as the chief engineer has, instead of the *best* line of railway that could have been determined on, decided on that which, for the *reasons* stated, it is *advisable* he should recommend —alas! what a pity it is that, in the construction of our great arterial railways, such a discreditable difference should have been allowed to exist!!—he employs his assistant engineers and surveyors to make for him accurate surveys, and to take correct sections, copies of which are to be deposited, according to Act of Parliament, with the various clerks of the peace of the several counties through which the line is to pass, with the Commissioners of Railways, &c. &c. &c.; besides which there is to be prepared for each parish its proportion, as also for every landholder a section, showing the greatest depth of cutting or embankment in any of his fields.

In addition to the collection and construction of all these data and drawings, notices are to be served upon every landowner, wherever he may be, in the United Kingdom; for which duty in 1845 almost everybody that could be picked up was engaged, the number of horses employed and *killed* in the operation having been utterly incalculable.

4. By the time these expenses have been incurred, the attention of the chief engineer is engrossed by a new struggle of vital importance, practically called "*the fight for the Act*," in both houses of Parliament.

on before the reader is abstractedly one of sci-

refrain from staining it by the slightest poli-

tical remark; we will therefore, on this branch of the subject, only state that, from returns which have officially been published, it appears that, in the years 1845, 1846, and 1847, more than ten millions were expended in parliamentary inquiries and parliamentary contests.

This money would, at the rate of 20,000*l.* per mile, have constructed a national railway 500 miles in length—say from London to Aberdeen!

Casting aside the bitter mortification which these expenses must create to the man of science, whose mind is enthusiastically engrossed with the vast importance of railway communication, the permanent tax which they inflict upon the public can very briefly be demonstrated.

Supposing 5 per cent. be deemed an adequate return to railway proprietors for the capital they have expended, the comparative charges to be levied by them on every passenger or ton of goods would, on a given traffic, be as follows:—

Charge per mile on a railway which ought to have cost 15,000*l.* per mile	1*d.* per mile.
Ditto on a railway which has unnecessarily been made to cost 20,000*l.* per mile	1½*d.* „
Ditto on a railway which has unnecessarily been made to cost 25,000*l.* per mile	1¾*d.* „
Ditto on a railway which has unnecessarily been made to cost 30,000*l.* per mile	2*d.* „

5. As soon as the Act of Parliament has been obtained, the chief engineer directs the immediate construction of a most accurate plan and section of the whole line, from which he ascertains and lays down its gradients. He then determines the sizes of the bridges required, as also the nature and amount of masonry for each; he calculates the quantities of embankments and cuttings, balancing the one against the other as nearly as circumstances will allow, and having, by first boring, and afterwards by the sinking of "trial shafts," ascertained as accurately as possible the nature of the various strata to be excavated or tunnelled, he proceeds to estimate in detail the cost of the several works, which he then divides into lengths for construction, taking care that in each the amount of earth to be excavated and filled

up shall as nearly as possible balance each other; in short, inasmuch as all contractors prudently, and indeed very properly, invariably lower their tenders in proportion as the work they are required to execute has been clearly laid open to their view, and, on the other hand, to secure themselves from unknown difficulties, as invariably *raise* their tenders for work which has not been sufficiently bored or examined, he is fully sensible that a considerable saving in the cost of the proposed railway will be effected by a clear preliminary development of its works.

6. This mass of information having been prepared, the chief engineer now advertises his work in its various lengths for execution by contract, and, on receiving tenders for the same, he selects, not always the *lowest*, but that which, for various reasons, is the most *approved*, taking security generally to the amount of 10 per cent. of the contract.

Previous, however, to the reception of the tenders the chief engineer appoints his staff of assistants. To each 40 or 50 miles there is usually appointed an experienced engineer, having under him "*sub-assistants*," who superintend from 10 to 15 miles each—these sub-assistants being again assisted by "*inspectors*" of masonry, of mining, of earth-work, and of permanent way, to each of whom a particular district is assigned.

7. The chief engineer now finds himself engaged in a new struggle with man in addition to nature. In many instances the contractors let out a portion of the work they have engaged to perform to sub-contractors, who again "set" the earth-work to a body of "navvies," who again among themselves sub-divide it among the three branches of which their State is composed, namely, "excavators," "trenchers," and "runners," each party of whom appoint their own "ganger."

The duty of effectually overlooking all these details, of preventing collusion as well as collision, of enforcing the due execution of the contract, and yet, where necessary, occasionally to alleviate the strict letter of its law, constitute perhaps the most harassing of the various difficulties which the chief engineer has to overcome: for it must be evident that if, by means of bribery, *or from inattention*, or from sheer roguery, any important portion

of the work be "scamped," or insufficiently performed, results may ere long occur of the most serious description.

TUNNELS.

8. The brief history of the construction of the Kilsby Tunnel of the London and North-Western Railway very strikingly demonstrates the latent difficulties which occasionally evade the investigations, baffle the calculations, and which, by chastening as well as by humbling, eventually elevate the mind of every man of science who has practically to contend with the hidden secrets of the crust of the earth which we inhabit.

The proposed tunnel was to be driven about 160 feet below the surface. It was to be, as indeed it is, 2399 yards 2 feet 6 inches in length, with two shafts of the extraordinary size of 60 feet in diameter, not only to give air and ventilation, but to admit light enough to enable the engine-driver in passing through it with a train to see the rails from end to end.

In order correctly to ascertain, and honestly to make known to the contractors, the nature of the ground through which this great work was to pass, the engineer in chief sank the usual number of what are termed "trial shifts," and, it clearly appearing therefrom that the principal portion of the stratum was the shale of the lower oolite, the usual advertisements for tenders were issued, and the shafts, &c., having been minutely examined by the competing contractors, the work was let to one of them for the sum of 99,000*l.*

In order to drive the tunnel, it was deemed necessary to construct 18 working shafts, by which, like the heavings of a mole, the contents of the subterranean gallery were to be brought to the surface.

This interesting work was in busy progress, when all of a sudden it was ascertained, that at about 200 yards from the south end of the tunnel, there existed, overlaid by a bed of clay 40 feet thick, a hidden quicksand, which extended 400 yards into the proposed tunnel, and which the trial shafts on each side of it had *almost miraculously* just passed without touching.

The traveller in India could scarcely be more alarmed at the sudden sight of a crouching tiger before him, than the contractor was at the unexpected appearance of this invincible enemy. Overwhelmed at the discovery, he instantly took to his bed, and though he was liberally, or, to speak more correctly, justly relieved by the Company from his engagement, the reprieve came too late, for he actually died!

The question then arose whether, in the face of this tremendous difficulty, the execution of the Kilsby Tunnel should be continued or abandoned. The general opinion of the several eminent engineers who were consulted was against proceeding, and certainly the amount of the difficulties which were subsequently incurred, justified the verdict. But in science, as well as in war, the word "IM*possible*" can occasionally, by cool and extraordinary exertions, be divested of its first syllable; and accordingly, Mr. Robert Stephenson offering, after mature reflection, to undertake the responsibility of proceeding, he was duly authorised to do so.

His first operation was of course to endeavour by the power of steam-engines—the comrades of his life—to lower the water with which he had to contend; and although, to a certain degree, this attempt succeeded, yet by the draining of remote springs, and by the sinking of the water in wells at considerable distances, it was soon ascertained that the quicksand in question covered several square miles.

The tunnel, 30 feet high by 30 feet broad, arched at the top as well as the bottom, was formed of bricks laid in cement, and the bricklayers were progressing in "lengths" averaging 12 feet, when those who were nearest the quicksand, on driving into the roof, were suddenly almost overwhelmed by a deluge of water which burst in upon them. As it was evident that no time was to be lost, a gang of workmen, protected by the extreme power of the engines, were with their materials placed on a raft; and while, with the utmost celerity, they were completing the walls of that short length, the water, in spite of every effort to keep it down, rose with such rapidity, that at the conclusion of the work the men were so near being jammed against

the roof, that the assistant-engineer, Mr. Charles Lean, in charge of the party, jumped overboard, and then, swimming with a rope in his mouth, he towed the raft to the foot of the nearest working shaft, through which he and his men were safely lifted up into daylight, or, as it is termed by miners, "*to grass.*"

The water now rose in the shaft, and as it is called "drowned out" the works. For a considerable time all the pumping apparatus appeared to be insufficient. Indeed the effort threatened to be so hopeless that the Directors of the Company almost determined to abandon it, but the engineer-in-chief, relying on the power of his engines, prayed for one fortnight more; before that period expired Science triumphed over her subterranean foe, and—thanks to the inventors of the steam-engine—the water gradually lowered.

By the main strength of 1250 men, 200 horses, and 13 steam-engines, not only was the work gradually completed, but during night and day, for eight months, the astonishing and almost incredible quantity of 1800 gallons per *minute* from the quicksand alone was raised by Mr. Robert Stephenson and conducted away!!

Indeed such is the eagerness with which workmen in such cases proceed, that, on a comrade being one day killed at their side by falling down the shaft, they merely, like sailors in action, chucked his body out of the way and then instantly proceeded with their work. In the construction of the tunnel there were lost twenty-six men, two or three of whom were "navvies," killed in trying, "for fun,"—as they termed it—to jump one after another across the summits of the shafts.

The time occupied from the laying of the first brick to the completion of the work was thirty months. The number of bricks used was 36,000,000, sufficient to make a good footpath from London to Aberdeen (missing the Forth) a yard broad!

On the completion of this great work the large populous village which had been constructed on its summit was of course suddenly deserted; it has since completely disappeared, and, instead of the busy scenes it once witnessed, there is now nothing heard on the *dreary summit* of the Kilsby Tunnel but the desolate

moan of the rumbling train, or the occasional subterranean whistle of its engine; these noises being followed by the appearance of a slight smoke slowly meandering upwards from the two great shafts of the tunnel.

During the operations we have just described, an artificer who had been working in the tunnel was ascending one of the shafts when, the back of his coat happening to get into an angular crevice of the partition, called by miners a "*brattice*," which separated the shaft from the pumps, it became so completely jammed therein that the man was obliged to let go the rope, and accordingly, while dangling over his head it rose to the surface, he remained, to the utter astonishment and dismay of his comrades, suspended about 100 feet from the bottom, until some of them descended and rescued him by cutting away the imprisoned piece of his coat, which, on being afterwards extricated, was long preserved in the engineer's office as a trophy demonstrating the strength of good honest English broadcloth.

At the same shaft an accident of exactly a contrary nature subsequently occurred. In order to execute some trifling repair to the brattice, there was, during a desperate cold night, suspended, about half-way down the shaft, a temporary scaffolding on which several artificers were working by candle-light, when all of a sudden a well-known powerful "navvy," named Jack Pierson, fell from the surface with such momentum, that, breaking through the frail scaffolding as if it had been tinder, he was in a few seconds heard to go souse into the water at a considerable depth beneath!

As soon as the men on the scaffold had recovered from their surprise they naturally all at once were animated with a desire to save their comrade. One lustily roared out for rope; another vociferously proposed something else; while several navvies, bawling from the surface, were each as eagerly and as loudly prescribing his own remedy. In the midst of this confusion the stentorian voice of Jack Pierson himself was heard, from the very bottom of the pit, calmly to exclaim,

"DARM YOUR EYES, MAKE LESS NOISE AND POOL ME *!!*"

His rough command was instantly attended to, and he was moreover carried to his bed, where, poor fellow! he lay many weeks unable to move.

Besides the 1250 labourers employed in the construction of the tunnel, a proportionate number of suttlers and victuallers of all descriptions concentrated upon the village of Kilsby. In several houses there lodged in each room sixteen navvies, and as there were four beds in each apartment, two navvies were constantly in each; the two squads of eight men as alternately changing places with each other in their beds as in their work.

Such was the demand for lodging that it was, as we have stated, found necessary to construct a large village over the tunnel for the accommodation of the workmen, and, as they generally allowed themselves three meat meals a-day, it has been asserted that more beef was eaten at Kilsby during the construction of the tunnel than had previously been consumed there since the Deluge.

As these navigators are now before us, we trust that our readers will not only be curious but desirous to know a little more of the habits of a set of men who have lately added so materially to the prosperity of the country as well as to our luxuries, by the numerous railways which, by the honest sweat of their brows, they have one after another executed.

We need hardly say that, as regards their physical strength, they are the finest Herculean specimens of the British race; and, as is generally the case, in proportion as they are powerful so are they devoid of all bluster or bravado.

Those who have commanded large numbers of them state that they are not only obedient to all above them, even to their own "gangers," but that, although they have—we think very justly—occasionally required a permanent increase of pay, they have never meanly taken advantage of a press of business to strike for wages. Indeed the conduct of a "navvy," like his countenance, is honest and open. If from illness or misfortune he is unable to work, he and his family are maintained by his comrades; in truth the same provision is made among them for what are called by navvies their "*tally-wives*," a description of relationship exceedingly difficult *correctly* to describe

As they earn high wages, it is a fashion among them to keep dogs; and as rather a noble trait, we may mention that there have been several instances where 10*l.* has been in vain offered to "a navvy" to induce him to sell his dumb favourite.

Generally speaking they are not addicted to poaching; but when not at work they usually amuse themselves by playing at skittles, at quoits, by drinking, and occasionally by fighting; and although the latter species of recreation is no doubt reprehensible, yet surely it is better for a man to walk homewards at night with a pair of black eyes and a bloody nose, than with an I O U cheque in his pocket for ten thousand pounds, gained by what the fashionable world terms "at *play*" from a companion whose wife he has made destitute, and whose children he has probably ruined!

At a navvy's funeral 500 of his comrades in their clean short white smock-frocks, with thin black handkerchiefs tied loosely round their throats, are seen occasionally in procession walking in pairs hand in hand after the coffin of their mate. In short, there exists among them a friendly "*esprit de corps*," which not only binds them together, but renders it rather dangerous for any stranger to cheat, or even to endeavour to overreach them.

During the construction of the present London and North-Western Railway, a landlady at Hillmorton, near Rugby, of very sharp practice, which she had imbibed in dealings for many years with canal boatmen, was constantly remarking aloud that no navvy should ever "*do*" her; and although the railway was in her immediate neighbourhood, and although the navvies were her principal customers, she took pleasure on every opportunity in repeating the invidious remark.

It had, however, one fine morning scarcely left her large, full-blown, rosy lips, when a fine-looking young fellow, walking up to her, carrying in both hands a huge stone bottle, commonly called "a grey-neck," briefly asked her for "half a gallon of gin;" which was no sooner measured and poured in than the money was rudely demanded before it could be taken away.

On the navvy declining to pay the exorbitant price asked, the

landlady, with a face like a peony, angrily told him he must either pay for the gin or *instantly* return it.

He silently chose the latter, and accordingly, while the eyes of his antagonist were wrathfully fixed upon his, he returned into her measure the half-gallon, and then quietly walked off; but having previously put into his grey-neck half a gallon of water, each party eventually found themselves in possession of half a gallon of gin and water; and, however either may have enjoyed the mixture, it is historically recorded at Hillmorton that the landlady was never again heard unnecessarily to boast "that no navvy could '*do*' her."

A navvy at Kilsby, being asked why he did not go to church? dully answered in geological language—"*Why, Soonday hasn't cropped out here yet!*" By which he meant that the clergyman appointed to the new village had not yet arrived.

The contrast which exists between the character of the French and English navigator may be briefly exemplified by the following trifling anecdote:—

In excavating a portion of the first tunnel east of Rouen towards Paris, a French miner dressed in his blouse, and an English "navvy" in his white smock jacket, were suddenly buried alive together by the falling in of the earth behind them. Notwithstanding the violent commotion which the intelligence of the accident excited above ground, Mr. Meek, the English engineer who was constructing the work, after having quietly measured the distance from the shaft to the sunken ground, satisfied himself that if the men, at the moment of the accident, were at the head of "the drift" at which they were working, they would be safe.

Accordingly, getting together as many French and English labourers as he could collect, he instantly commenced sinking a shaft, which was accomplished to the depth of 50 feet in the extraordinary short space of eleven hours, and the men were thus brought up to the surface alive.

The Frenchman, on reaching the top, suddenly rushing forwards, hugged and embraced on both cheeks his friends and acquaintances, many of whom had assembled, and then, almost

instantly overpowered by conflicting feelings,—by the recollection of the endless time he had been imprisoned—and by the joy of his release,—he sat down on a log of timber, and, putting both his hands before his face, he began to cry aloud most bitterly.

The English "navvy" sat himself down on the very same piece of timber—took his pit-cap off his head—slowly wiped with it the perspiration from his hair and face—and then, looking for some seconds into the hole or shaft close beside him through which he had been lifted, as if he were calculating the number of cubic yards that had been excavated, he quite coolly, in broad Lancashire dialect, said to the crowd of French and English who were staring at him as children and nursery-maids in our London Zoological Gardens stand gazing half terrified at the white bear,

"YAW'VE BEAN A DARMNATION SHORT TOIME ABAAOWT IT!"

In the construction of the London and North-Western Railway, the contractor at Blisworth also failed and also died.

Besides the perpendicular cutting which he had undertaken to execute, there was, on the surface of the rock through which it now passes, a stratum of about twenty feet of clay of so slippery a nature, that for a considerable time, in spite of all efforts or precautions, it continued to flow over into the cutting like porridge. The only remedy which could be applied was, at vast labour and expense, to remove this stratum for a considerable distance, terminating it by a slope at a very flat angle, all of which extra labour, trouble, and expense, we may observe, is not only unseen but unknown to the traveller, who, as he flies through the cutting, if he looks at the summit at all, naturally fancies that it forms the upper extremity of the work.

In the construction of the tunnel at Watford an accident occurred of rather a serious nature. A mass of loose gravel con- the chalk, slipping *viâ* the shaft into the tunnel, suddenly even men, besides letting down from the surface a horse

Cuttings.

9. In passing through the consecutive cuttings of a great railway, the traveller usually considers that those through rock must have been desperate undertakings, infinitely more expensive than those through clay. The cost of both, however, is nearly equal; for, not only does the perpendicular rock-cutting require infinitely less excavation than the wide yawning earth one of the same depth, but when once executed the former is not liable to the expensive slips which subsequently occasionally afflict the latter.

In determining whether the line should proceed by tunnelling or by cutting, the engineer's rule usually is to prefer the latter for any depth less than sixty feet; after which it is generally cheaper to tunnel. If, however, earth be wanted for a neighbouring embankment, it becomes of course a matter of calculation whether it may not be cheaper to make a cutting instead of what abstractedly ought otherwise to have been a tunnel.

In the construction of the Tring cutting alone of the present London and North-Western Railway, there were excavated 1,297,763 cubic yards of chalk, of which about fifteen cubic feet weighed a ton.

Embankments.

10. Besides contending with water above ground as well as below, the constructor of a railway is occasionally assailed by an element of a very different nature. For instance, when the Wolverhampton embankment of the present London and North-Western Railway, at vast trouble and expense, was nearly finished, it was observed first to smoke, then get exceedingly hot, until a slow mouldering flame visible at night appeared. The bank began to consume away, and the heat continued until it actually burned the railway sleepers; at last, however, it exhausted itself. The combustion was caused by the quantity of sulphuret of iron or pyrites contained in the earth of the embankment, which, having been baked by the fire, will probably never slip.

11. It would be tedious, and indeed impossible, to detail the various works which a railway engineer has to superintend in the construction of the line, in the laying down of the rails or "permanent way," and in the subsequent, or rather simultaneous, erection of the various station-houses, storehouses, workshops, &c. &c., the interior of which we shall soon have occasion to enter.

An idea, however, of the magnitude of his operations may be faintly imparted by the following brief abstract of a series of calculations made by Mr. Lecount, one of the engineers employed in the construction of the southern division of the present London and North-Western Railway, and the writer of the article '*Railways*' in the 'Encyclopædia Britannica.' The great Pyramid of Egypt was, according to Diodorus Siculus, constructed by three hundred thousand—according to Herodotus by one hundred thousand—men; it required for its execution twenty years, and the labour expended on it has been estimated as equivalent to lifting 15,733,000,000 of cubic feet of stone one foot high. Now, if in the same manner the labour expended in constructing the Southern Division only of the present London and North-Western Railway be reduced to one common denomination, the result is 25,000,000,000 cubic feet of similar material lifted to the same height; being 9,267,000,000 of cubic feet *more* than was lifted for the pyramid; and yet the English work was performed by about 20,000 men only, in less than five years.

Again, it has been calculated by Mr. Lecount that the quantity of earth moved in the single division (112½ miles in length) of the railway in question would be sufficient to make a foot-path a foot high and a yard broad round the whole circumference of the earth! the *cost* of this division of the railway in penny-pieces being sufficient to form a copper kerb or edge to it. Supposing therefore the same proportionate quantity of earth to be moved in the 7150 miles of railway sanctioned by Parliament at the commencement of 1848 (*Vide* Parliamentary Returns), our engineers within about fifteen years would, in the nstruction of our railways alone, have removed earth suffi-ent to girdle the globe with a road one foot high and one undred and ninety-one feet broad!

Abandoning, however, speculations of this nature, we will conclude our slight sketch of the principal works required for a railway by a few data, exemplifying the magnitude of the Britannia Bridge over the Menai Straits, the construction of which has been intrusted by its well-known inventor to the very able and experienced management of Mr. Frank Forster.

The dimensions of this straight wrought-iron aërial gallery, through which passengers and goods are to travel by rail, are—

	Feet. In.
Total length of bridge, divided into 4 openings— 2 of 230 feet 2 of 460 feet } each	1834 9
Height of rails above high-water mark	104 0
Quantity of masonry in the towers and abutments .	1,365,000 cubic feet.
Weight of one of the iron tubes for the largest span, to be lifted 100 feet.	1,800 tons.
Value of each of the largest of the iron tubes, not including expense of raising it	£54,000
The cost of the scaffolding now in use about the bridge has exceeded	£50,000

It would, we conceive, be impertinent to dilute the above facts by a single comment.

The Chief Engineer.

As the selection of an engineer-in-chief, competent to determine the best line for a projected railway to take, the mode in which it should be constructed, and, lastly, to execute his own project—deviating from it with consummate judgment according to the difficulties, physical, moral, and political, which, sometimes separately and sometimes collectively, suddenly rise up to oppose him—is a point not only of vital importance to the success of the undertaking, but in the undertaking is the *first* important point to be decided, it would, we were aware, have apparently been the most regular to have commenced the present chapter with this subject. We conceived, however, that instead of there detailing the qualifications necessary for the duties required, it would save us very many words, and our readers as much time, if we were to defer the consideration of that subject until a brief outline of

those duties should, without comment, practically explain the qualifications required.

If the United Kingdom had only projected the construction of one or two great arterial railways, we might naturally have expected that the few competent engineers necessary would readily have been obtained; but when we consider the number of railways that were simultaneously created, the surveys, plans, sections, and other preparations that were necessary, the magnitude of the works of various descriptions that were to be constructed in each, it must evidently to many be a subject of astonishment that there should have been found on the surface of our country not only the amount of engineering talent necessary for the execution of such vast works, but an amount which may truly be said to have exceeded the demand.

The curious historical fact, however, is, that the amount of engineering talent thus suddenly required existed not on *the surface* of our country, but, on the contrary, many hundred fathoms *beneath it.* The brilliant talents that were required were "black diamonds," without metaphor embedded in the bowels of the earth. Science called her spirits from the vasty deep, and in obedience to her commands there arose out of the shafts of our coaleries, and from beneath the bottom of the Thames—

OLD GEORGE STEPHENSON, who had served his articles of apprenticeship in a coal-mine, for many years working at the engines both above ground and below;

ISAMBARD BRUNEL, whose principal experience had been acquired in the construction of the Thames Tunnel;

JOSEPH LOCKE, a colliery-viewer, who had served his apprenticeship below ground;

ROBERT STEPHENSON, brought up as a coal-miner, served his apprenticeship at Killingworth colliery;

FRANK FORSTER had worked for seven years as an apprentice in a coal-mine;

NICHOLAS WOOD, ditto;

CHARLES LEAN, ditto;

And a crowd of similar genii, all slaves of the same lamp, or *Old Davy,*" as they term it.

To such men the difficulties attendant upon the construction of a railway were trifling as compared with those against which all their lives they had been contending.

For instance, he who along dark, intricate, subterranean passages, or "heavings," as they are termed, often only three feet and a half high, and occasionally only two feet high, creeping and crawling through foul air, could with great speed, not only with unerring certainty find his way, but in such a secluded study could plan a variety of new cuttings, each forming part and parcel of a reticulated system of excavation which an unpractised mind would find it utterly impossible to comprehend, would, it may easily be conceived, experience but little difficulty, when walking erect in sunshine and in balmy air, to carry in his mind from, say Harrow to Watford, Watford to Tring, Tring to Wolverton, and Wolverton to Birmingham, those great leading features of the surrounding country which would enable him to exercise for the laying out of a railway the judgment and decision required.

Again, what, it may justly be asked, are embankments, deep cuttings, and occasionally here and there a straight tunnel thirty feet broad, twenty-seven feet high, *usually forming by drainage its own adit*, in comparison with the overwhelming and intricate difficulties attendant upon—

1st. The excavation of coal from strata of various characters, at various depths, each passage or "air-heaving" requiring perhaps a different system of support.

2nd. Encountering at various depths quicksands.

3rd. The great as well as minute arrangements necessary for wheeling carriages and raising the coals.

4th. The organization and management of a subterranean army of men and horses.

5th, and lastly. Lifting by steam-power from various depths, by night and by day, streams, floods, and occasionally almost rivers of water?

It has been beneath the surface of our country that these and many other difficulties of vast magnitude—unknown to and unthought of by the multitude—have for many generations been

successfully encountered by science, capital, and by almost superhuman physical exertion; and it was accordingly, as we have stated, from beneath the surface of Great Britain that an organised corps of civil engineers, who, like those we have named, had regularly served as apprentices, arose, in the emergency of a moment, to assist their eminent brother engineers above ground, in constructing for the country the innumerable railways so suddenly required.

CHAPTER II.

On the Maintenance of the Permanent Way.

As soon as an infant railway can run alone—we mean as soon as its works are all constructed, its permanent way finished, its buildings executed, its locomotive engines as well as its carriages constructed, and its whole establishment of officers and men appointed and organised—the chief engineer, like a month-nurse, usually departs to new troubles, leaving the maintenance of the way to those of his assistants whom he considers, and who in the opinion of the Directors of the Company are deemed, the most competent to execute its various details.

The manner in which this important duty is performed on the London and North-Western Railway is very briefly as follows:—

The line is, according to the nature of its works, divided into distances of from 17 to 30 miles, to each of which there is appointed "*an overlooker*," whose district is subdivided into "lengths" of one or two miles, to each of which is appointed "*a foreman*," with his gang of two or three men.

Every morning before the first train passes, the foreman is required to walk over his length, not only generally to inspect it, but especially to ascertain that each of the wooden keys which secure the rails are firmly fixed; and in case of any deficiency, his first operation is to put up, 800 yards above the point, a signal flag, which flies until the necessary repair is executed.

The ambition of the superintendent of the division is, however, to execute all necessary repairs not only with the utmost promptitude and despatch, but, if possible, without impeding the passage of the public; and considering the number of up and down passenger, goods, and coal trains (vide 'Bradshaw's List') that are continually passing along the line, the success with which this object can, in railway management, be practically attained is worthy of explanation. For instance—

1. In February, 1848, three miles of single rails were relaid by the Company's engineer in Kilsby Tunnel; 125 men and one ballast-engine being employed in this work for four weeks, without stopping the public.

2. The Beech Wood Tunnel (situated about five miles north of Coventry, and about 300 yards in length) was entirely relined with bricks. Two hundred workmen were employed in this troublesome operation for about six weeks without a single accident, and without stopping the public, who, indeed, probably, during the whole period of the repair, passed through without being even aware of the execution of the job.

3. Between June, 1845, and October, 1848, the Company's engineer of the Southern District relaid 57 miles of single line of railway without stopping a train and without accident.

At the Agricultural Meeting at Northampton in July, 1847, upwards of 11,000 persons were sent to Northampton, and 13,000 returned in the evening, the carriages they occupied forming one mass as far as the eye could reach. From the Company's returns it appears that, of the above number, not a single person received any injury; and although, from some unaccountable reason, a good many of them on their return walked, it is whispered, zigzaggedly, only two out of the whole number were despatched to wrong destinations.

As the above facts require no comment, it is merely necessary to explain by what description of arrangements the works of a great railway can be repaired and renewed without stopping the public

The two following specimens of the directions issued on such occasions by the Company's superintendent will best give the information required:—

LONDON AND NORTH-WESTERN RAILWAY.

Superintendent's Office, Euston Station,
22nd January, 1848.

RELAYING THE RAILS IN THE KILSBY TUNNEL.

The Engineer Department have given notice that the workmen are ready to commence removing the stone blocks and relaying the rails in the Kilsby Tunnel.

The *Electric* Telegraph having been laid through the Tunnel, the

work is to commence on the night of Wednesday the 2nd of February, and during its continuance the traffic is to be conveyed over one Line from the passing of the Up Lancashire Express Train (say 9 P.M.) until 8 o'clock the following morning, when the Up Line is to be clear for the passage of the 7 A.M. Train from Birmingham.

The passage of the Trains through the Tunnel during the night is to be under the following regulations:—

The *Red* Signal is to be kept on at each entrance to the Tunnel during the hours the traffic has to pass over the same Line; and every Train, whether Up or Down, is to stop short of the Cross Road laid down at the Tunnel mouth.

As a guide to the Drivers where to stop, a Post has been erected, upon which a Red Light will be shown, and beyond which the Engine is not to advance.

As a further precaution during the hours of relaying, the *Green* Signal is to be shown at Crick, and by the Policeman stationed at Hillmorton Ballast Pit, as notice to the Drivers in either direction to shut off the steam.

On the approach of a Train to either entrance, the Policeman on duty is to sound the Telegraph Bell, whereupon the Policeman at the other end will respond by sounding his Bell; and immediately after telegraph "*Line clear*," or "*Line blocked*," as the case may be.

If the answer be "*Line clear*," the Train is to be allowed to enter the Tunnel, the Policeman at the entrance telegraphing back to the other end "*Train in*," whereupon he will not again telegraph, or allow any Engine to enter the Tunnel, until he receives Telegraph Notice from the other end "*Train out*."

The same process and precaution is to be observed with every Train that may arrive, and no Signal is to be considered received and understood until responded to.

Whichever end first rings the bell to announce the approach of a Train, that Train is to have the precedence, and a Train arriving at the other end is to be kept clear of the Crossing Points until the first announced Train has passed, when, after telegraphing "*Train out*," and getting the response from the other end, the Policeman at that end will ring his bell as notice that he has a Train waiting to enter, which is to be allowed to proceed after passing the Signals as before described.

Three Policemen are also to be stationed in the Tunnel with Fog Signals and Hand Lamps, to signal the Trains as they pass through; and one additional at each entrance, to assist in the Signals and crossing the Trains.

The Drivers are to be strictly enjoined to approach the Tunnel with caution, as a Train may be standing outside, and on passing through they are to be prepared to bring their Train to a stand, should it be necessary to stop unexpectedly.

H. P. BRUYERES.

LONDON AND NORTH-WESTERN RAILWAY.

Superintendent's Office, Euston Station,
30th August, 1848.

RELAYING OF THE UP LINE BETWEEN BERKHAMPSTEAD AND TRING.

The Engineer Department have notified that they are prepared to relay a portion of the Up Line, between the 27¾ and 30 Mile Posts, north of Berkhampstead Station.

The plate-layers are to work at the undermentioned times, viz.:—

From 3.50 A.M. to 5.40 A.M.

That is, after the passing of the 12.15 Night Mail Passenger Train from Birmingham, until the 2.0 A.M. Goods Train from Rugby becomes due. Again—

From 7.50 A.M. to 8.55 A.M.

That is, after the passing of the 6.45 A.M. Wolverton Passenger Train, until the 7.15 A.M. Passenger Train from Northampton becomes due. Again—

From 9.55 A.M. to 10.50 AM.

That is, after the passing of the 7.0 A.M. Passenger Train from Birmingham, until the 9.45 A.M. Passenger Train from Bedford becomes due. Again—

From 12.40 Noon to 1.50 P.M.

That is, after the passing of the 10.35 Goods Train from Wolverton, until the 10.30 A.M. Passenger Train from Birmingham becomes due, when the relaying will cease for the day.

The interval from 12.40 Noon to 1.50 P.M. for relaying will be allowed daily, except on Thursdays and Saturdays, on which days, in consequence of the Up Special Cattle Trains, the relaying is to cease after the third interval, viz at 10.50 A.M.

Although all the Up Trains will travel on their own line, should any arrive out of course during the hours the Relaying Party are engaged, they are not to proceed forward on their journey until advised by the Policeman engaged with the Workmen that the Line is ready for their passage

Until the relaying be reported complete, the Drivers and Guards of

all Up Trains are to be instructed before leaving Wolverton that they are to be in readiness to stop on the instant the Policeman engaged with the Working Party signals them to do so.

A Policeman is to be specially appointed to attend the Working Party, and stop any Train should it be necessary.

The work to commence on Friday next, the 1st of September.

No Pilot Engine is to be allowed to leave Tring on its return to London during the time of the four intervals allotted to the Relaying Party.

(Signed) H. P. BRUYERES.

In cases of slips of embankments or other heavy accidents of any description, the Company's engineer is prepared to collect and forward to the spot with the utmost possible despatch the amount of men and materials required.

Having concluded a very faint outline of the difficulties attendant upon the construction of a great railway, and upon the maintenance of its permanent way, we will now proceed very briefly to describe the practical working of the whole concern.

CHAPTER III.

THE TRAINS—EUSTON.

The Down Train.

ON arriving in a cab at the Euston Station, the old-fashioned traveller is at first disposed to be exceedingly pleased at the new-born civility with which, the instant the vehicle stops, a porter, opening its door with surprising alacrity, most obligingly takes out every article of his luggage; but so soon as he suddenly finds out that the officious green straight-buttoned-up official's object has been solely to get the cab off the premises, in order to allow the string of variegated carriages that are slowly following to advance—in short, that, while he has been paying to the driver, say only two shining shillings, his favourite great-coat, his umbrella, portmanteau, carpet-bag, Russia leather writing-case, secured by Chubb's patent lock, have all vanished—he poignantly feels, like poor Johnson, that his "patron has encumbered him with help;" and it having been the golden maxim of his life never to lose sight of his luggage, it gravels and dyspepsias him beyond description to be civilly told that on no account can he be allowed to follow it, but that "*he will find it on the platform;*" and truly enough the prophecy is fulfilled; for there he does find it on a barrow in charge of the very harlequin who whipped away, and who, as its guardian angel, hastily muttering the words "*Now then, Sir!*" stands beckoning him to advance.

The picture of the departure of one of the large trains from
[illegible]on at Euston Square, however often it may have been
[illegible]worthy of a few moments' contemplation.
[illegible]at covered platform, which, with others adjoining
from above by 8797 square yards (upwards of an

acre and three-quarters) of plate-glass, are to be seen congregated and moving to and fro in all directions, in a sort of Babel confusion, persons of all countries, of all religions, and of all languages. People of high character, of low character, of no character at all. Infants just beginning life—old people just ending it. Many desirous to be noticed—many, from innumerable reasons, good, bad, and indifferent, anxious to escape notice. Some are looking for their friends—some, suddenly turning upon their heels, are evidently avoiding their acquaintance.

Contrasted with that variety of free and easy well-worn costumes in which quiet-minded people usually travel, are occasionally to be seen a young couple—each, like a new-born baby, dressed from head to foot in everything perfectly new—hurrying towards a coupé, on whose door there negligently hangs a black board—upon which there is printed, not unappropriately, in white bridal letters, the word "ENGAGED."

Across this mass of human beings a number of porters are to be seen carrying and tortuously wheeling, in contrary directions, baggage and property of all shapes and sizes. One is carrying over his right shoulder a matted parcel, 12 or 15 feet long, of young trees, which the owner, who has just purchased them for his garden, is following with almost parental solicitude. Another porter, leaning as well as walking backwards, is attempting with his whole strength to drag towards the luggage-van a leash of pointer-dogs, whose tails, like certain other "tails" that we know of, are obstinately radiating from the couples that bind together their heads: while a number of newspaper-vendors, "fleet-footed Mercuries," are worming their way through the crowd.

Within the long and apparently endless straight line of railway carriages which bound the platform, are soon seen the faces and caps of various travellers, especially old ones, who with due precaution have taken possession of their seats; and while most of these, each of them with their newspapers unfolded on their knees, are slowly wiping their spectacles, several of the younger inmates are either talking to other idlers leaning on their carriage-windows, or, half kissing and half waving their hands, are

bidding "farewell" to the kind friends who had accompanied them to the station.

Some months ago, at a crisis similar to that just mentioned, we happened to be ensconced in the far corner of a railway carriage, when we heard a well-known clergyman from Brighton suddenly observe to his next neighbour who sat between us, "*There must surely be something very remarkable in that scene!*" His friend, who was busily cutting open his *Record*, made no reply, but, as we chanced to witness the trifling occurrence alluded to, we will very briefly describe it. A young man of about twenty-two, of very ordinary height, dress, and appearance, was standing opposite to a first-class carriage just as the driver's whistle shrilly announced the immediate departure of the train. At this signal, without any theatrical movement or affectation of any sort, he quietly reeled backwards upon a luggage-truck, which happened to be immediately behind him. Two elderly ladies beside him instantly set to work, first of all, most vigorously to rub with their lean fingers the palms of his hands—they might just as well have scrubbed the soles of his boots;—then they untied his neckcloth; but their affectionate kindness was of no avail. The train was probably separating him from something, or from some one. The movement however he had not witnessed, for the mere whistle of the engine had caused him to swoon! What corresponding effect of fainting or sobbing it may have produced on any inmate in that carriage before which he had long been standing, and which had just left him, we have no power to divine. It is impossible, however, to help reflecting what a variety of emotions must every day be excited within the train as well as on the platform at Euston Station by the scream or parting whistle which we have just described. From the murderer flying from the terrors of justice down to the poor brokenhearted creditor absconding from his misfortunes;—from our careworn Prime Minister down to the most indolent member of either House of Parliament—each simultaneously escaping after a long-protracted session;—from people of all classes going from or to laborious occupation, down to the schoolboy reluctantly returning to, or joyfully leaving, his

school;—from our Governor-General proceeding to embark for India, down to the poor emigrant about to sail from the same port to Australia—the railway-whistle, however unheeded by the multitude, must oftentimes have excited a variety of feelings which it would be utterly impossible to describe.

While the travellers of a train are peacefully taking their seats, artillery-men, horses, and cannon, on a contiguous set of rails, are occasionally as quietly embarking in carriages, horse-boxes, and trucks, which are subsequently hooked on to a mass of passengers perfectly unconscious of the elements of war which are accompanying them.

As a departing railway-train, like a vessel sailing out of harbour, proceeds on its course, its rate rapidly increases, until, in a very short time, it has attained its full speed, and men of business are then intently reading the "City news," and men of pleasure the leading article of their respective newspapers, when this runaway street of passengers—men, women, and children—unexpectedly find themselves in sudden darkness, visible only by a feeble and hitherto unappreciated lamp, which, like the pale moon after a fiery sunset, modestly shines over their head. By this time the boarded platform at Euston Station, but a few minutes ago so densely thronged with passengers, is completely deserted. The lonely guard on duty, every footstep resounding as he walks, paces along it like a sentinel. The newspaper-vendors, sick unto death of the news they had been vaunting, are indolently reclining at their stalls; even the boy who sells 'Punch' is half asleep; and there is nothing to break the sober dulness of the scene but a few clerks and messengers, who, like rabbits popping from one hole of their warren into another, enter upon the platform from the door of one office to hurry into that of the next. In a few minutes, however, the loud puffing of an engine announces the approach towards the platform of a string of empty carriages, which are scarcely formed into the next departure train, when vehicles of all descriptions are again to be seen in our most public thoroughfares concentrating upon the focus of Euston Square; and thus, with a certain alleviation on Sundays, this strange feverish admixture of confusion and quiet-

ness, of society and solitude, continues intermittently from ½ past 6 A.M. to 10 P.M. during every day in the week, every week in the month, and every month in the year.

The Up Train.

The out-train having been despatched, we must now beg our readers to be so good as to walk, or rather to scramble, with us from the scene of its departure across five sets of rails, on which are lying, like vessels at anchor in a harbour, crowds of railway-carriages preparing to depart, to the opposite platform, in order to witness the arrival of an incoming train. This platform, for reasons which will shortly appear, is infinitely longer than that for the departure trains. It is a curve 900 feet in length, lighted by day from above with plate-glass, and at night by 67 large gas-lamps suspended from above, or affixed to the iron pillars that support the metallic net-worked roof. Upon this extensive platform scarcely a human being is now to be seen; nevertheless along its whole length it is bounded on the off-side by an interminable line of cabs, intermixed with private carriages of all shapes, gigs, dog-carts, and omnibuses, the latter standing opposite to little ugly black-faced projecting boards, which by night as well as by day are always monotonously exclaiming, "*Holborn—Fleet Street—and Cheapside!*"—"*Oxford Street—Regent Street—and Charing Cross!*" *&c.*

In this motley range of vehicles, smart coachmen, tall pale powdered footmen, and splendid horses are strangely contrasted with the humble but infinitely faster conveyance—the common cab. Most of the drivers of these useful machines, strange to say, are absent; the remainder are either lolling on benches, or, in various attitudes, dozing on their boxes. Their horses, which are generally well-bred, and whose bent knees and fired hocks proclaim the good services they have performed, stand ruminating with a piece of sacking across their loins, or with nose-bags often empty—until for some reason a carriage before them their line: in which case, notwithstanding the absence of drivers and regardless of all noises, they quietly advance the edge of the little precipice which bounds the rails.

They there know quite well what they are waiting for, and have no desire to move. Indeed, it is a Pickwickian fact, well known to cab-drivers, that their horses travel unwillingly from the station, but always pull hard coming back, simply because it is during the waiting-time at Euston Station that their nose-bags are put on—or, in other words, that they are fed.

We may here observe that there are sixty-five selected cabmen who have the *entrée* to the platform, and who, *quamdiù se bene gesserint*, are allowed exclusively to work for the Company, whose name is painted on their cabs. If more than these are required, a porter calls them from a line of supplicant cabs standing in the adjacent street. Close to each departure-gate there is stationed a person whose duty it is to write down in a book the number of each cabman carrying away a passenger, as well as the place to which he is conveying him, which two facts each driver is required to exclaim as he trots by; and thus any traveller desirous to complain of a cabman, or who may have left any property in a carriage from Euston Station, has only to state on what day and by what train he arrived, also whither he was conveyed, and from these data the driver's name can at any lapse of time be readily ascertained.

But our attention is suddenly claimed by something of infinitely more importance than a passenger's luggage: for that low unearthly whine within the small signal-office behind the line of cabs and carriages requires immediate explanation.

The variety of unforeseen accidents that might occur by the unwelcome arrival of an unexpected or even of an expected passenger-train at the great terminus of the London and North-Western Railway are so obvious that it has been deemed necessary to take the following precautions.

As soon as the reeking engine-funnel of an up-train is seen darting out of the tunnel at Primrose Hill, one of the Company's servants stationed there, who deals solely in compressed air—or rather, who has an hydraulic machine for condensing it—allows a portion to rush through an inch iron pipe; and he thus instantaneously produces in the little signal-office on the up-platform of Euston Station, where there is always a signal-man watching

by night as well as by day, that loud melancholy whine which has just arrested our attention, and which will continue to moan uninterruptedly for five minutes:—

"Hic vasto rex Æolus antro
Luctantes ventos tempestatesque sonoras
Imperio premit, ac vinclis et carcere frenat.
Illi indignantes magno cum murmure fremunt."

The moment this doleful intimation arrives, the signal-man, emerging from his little office, touches the trigger of a bell outside his door, which immediately in two loud hurried notes announces to all whom it may concern the arrival at Camden Station of the expected up-train; and at this moment it is interesting to watch the poor cab-horses, who, by various small muscular movements, which any one acquainted with horses can readily interpret, clearly indicate that they are perfectly sensible of what has just occurred, and quite as clearly foresee what will very shortly happen to them.

As soon as the green signal-man has created this sensation among bipeds and quadrupeds, taking with him the three flags, of danger (red), caution (green), and security (white), he proceeds down the line a few yards to a point from which he can plainly see his brother signal-man stationed at the mouth of the Euston tunnel. If any obstruction exists in that direction, the waving of the red flag informs him of it; and it is not until the white one from the tunnel as well as that from the station-master on the platform have reported to him that "all is clear" that he returns to his important but humble office (12 feet in length by 9 in breadth) to announce, by means of his compressed-air apparatus, this intelligence to the ticket-collector at Camden Station, whose strict orders are, on no account whatever to allow a train to leave his platform until he has received through the air-pipes, from the signal-office at Euston Station, the Company's luguus authority to do so.

n the latter office there are also the dial and wires of an ctric telegraph, at present inoperative. The signal-man, howr, *mentioned to* us the following trifling anecdote, as illus-

trative of the practical utility of that wonderful invention, which has so justly immortalized the names of Cooke and Wheatstone. An old general officer, who, from his residence some miles beyond Manchester, had come up to Euston Station on an invitation from the East-India Directors to be present at the dinner to be given by them to Lord Hardinge, found on his arrival that it would be necessary he should appear in regimentals: and the veteran, nothing daunted, was proposing to return to Manchester, when the signal-man at Euston advised him to apply for them by electric telegraph. He did so. The application, at the ordinary rate of 280,000 miles (about twelve times the circumference of the earth) *per second*, flew to Manchester; in obedience to its commands a porter was instantly despatched into the country for the clothes, which, being forwarded by the express train, arrived in abundant time for the dinner. The charge for telegraph and porter was 13*s*. 8*d*.

About four minutes after the up-train has been authorised by the air-pipe to leave Camden Station, the guard who stands listening for it at the Euston tunnel, just as a deaf man puts his ear to a trumpet, announces by his flag its immediate approach; on which the signal-man at the little office on Euston platform again touches his trigger, which violently convulsing his bell as before, the cab-horses begin to move their feet, raise their jaded heads, prick up their ears, and champ their bits; the servants in livery turn their powdered heads round; the Company's porters, emerging from various points, quickly advance to their respective stations; and this suspense continues until in a second or two there is seen darting out of the tunnel, like a serpent from its hole, the long dark-coloured dusty train, which, by a tortuous movement, is apparently advancing at its full speed. But the bank-riders, by applying their breaks—without which the engineless train merely by its own gravity would have descended the incline from Camden Station at the rate of forty miles an hour—soon slacken its speed, until the Company's porters at a brisk walk are preparing to unfasten one after another the doors of all the carriages.

While they are performing this popular duty, numerous salu-

tations, and kissings of hands of all colours and sizes, are seen to pass between several of the inmates of the passing train and those seated in or on the motley line of conveyances standing stock still which have been awaiting their arrival. A wife suddenly recognises her husband, a mother her four children, a sister her two dear brothers; Lord A. B. politely bows to Lady C. D.; John, from his remote coach-box, grins with honest joy as faithful Susan glides by; while Sally bashfully smiles at "a gentleman" in plush breeches reclining in the rumble of the barouche behind it.

As soon as the train stops, a general "sauve qui peut" movement takes place, and our readers have now an opportunity of observing that, just as it is hard to *make* money, easy to spend it, so, although it consumes at least twenty minutes to fill and despatch a long train, it scarcely requires as many seconds to empty one. Indeed, in less than that short space of time the greater number of the railway carriages are often empty!

When every person has succeeded in liberating himself or herself from the train, it is amusing to observe how cleverly, from long practice, the Company's porters understood the apparent confusion which exists. To people wishing to embrace their friends—to gentlemen and servants darting in various directions straight across the platform to secure a cab or in search of private carriages—they offer no assistance whatever, well knowing that none is required. But to every passenger whom they perceive to be either restlessly moving backwards and forwards, or standing still, looking upwards in despair, they civilly say "*This way, Sir!*" "*Here it is, Ma'am!*"—and thus, knowing what they want before they ask, they conduct them either to the particular carriage on whose roof their baggage has been placed, or to the luggage-van in front of the train, from which it has already been unloaded on to the platform; and thus, in a very few minutes after the convulsive shaking of hands and the ·erish distribution of baggage have subdivided, all the cabs and ages have radiated away—the parti-coloured omnibuses have red them—even the horses, which in different clothing have disembarked, have been led or ridden away—and, the foot

passengers having also disappeared, the long platform of the incoming train of the Euston Station remains once more solely occupied by one or two servants of the Company, hemmed in by a new line of expectant cabs and omnibuses. Indeed, at various periods of the day, a very few minutes only elapse before, at the instigation of compressed air, the faithful signal-bell is again heard hysterically announcing the arrival of another train at Camden Station.

In a clear winter's night the arrival of an up-train at the platform before us forms a very interesting picture.

No sound is heard in the cold air but the hissing of a pilot engine, which, like a restless spirit advancing and retrograding, is stealing along the intermediate rails, waiting to carry off the next down-train; its course being marked by white steam meandering above it and by red-hot coals of different sizes which are continually falling from beneath it. In this obscure scene the Company's interminable lines of gaslights (there are 232 at the Euston Station), economically screwed down to the minimum of existence, are feebly illuminating the damp varnished panels of the line of carriages in waiting, the brass doorhandles of the cabs, the shining haims, brass browbands and other ornaments on the drooping heads and motionless backs of the cab-horses; and while the blood-red signal lamp is glaring near the tunnel to deter unauthorised intrusion, the stars of heaven cast a faint silvery light through the long strips of plate-glass in the roof above the platform. On a sudden is heard—the stranger hardly knows whence—the mysterious moan of compressed air, followed by the violent ringing of a bell. That instant every gaslight on and above a curve of 900 feet suddenly bursts into full power. The carriages, cabs, &c. appear, comparatively speaking, in broad daylight, and the beautiful iron reticulation which sustains the glazed roof appears like fairy work.

CHAPTER IV.

The Railway Carriages.

We will now proceed to detail a few circumstances respecting the railway carriages, about which our readers have probably never cared to inquire.—And, *firstly*, as soon as an up-train arrives at the commencement of the Euston platform, while it is still in motion, and before its guard—distinguished by a silver-buckled black shiny patent-leather belt, hanging diagonally across the white buttons of his green uniform-coat—has ventured with practised skill to spring from the sideboard of the train to the platform, two greasy-faced men in canvas jackets, with an oil-can in each of their right hands and with something like a mophead of dirty cotton hugged under each of their left arms, are to be seen running on each side of the rails below in pursuit of the train; and while the porters, holding the handles of the carriage doors, to prevent any traveller from escaping, are still advancing at a brisk walk, these two oilmen, who have now overtaken the train, diligently wipe as they proceed the dust and perspiration from the buffer-rods of the last carriage. As soon as these irons are perfectly clean and dry rubbed, they oil them from their can; and then—crawling beneath the open doors of the carriages and beneath the feet and ankles of a crowd of exuding travellers of all ages, who care no more for oilmen than the oilmen of this world care for them—they hurry to the buffer-rods of the next carriage—and so rapidly do they proceed, that before the last omnibus has driven off, the buffer-rods of the whole train are as bright as when new. But, *secondly*, these two men have been closely followed by two others in green jackets—one on each side of the carriage—who deal solely in a yellow composition of tallow and palm-oil. Carrying a wooden box full of this ointment in one hand and a sort of short flat salve-knife in the other,

they open with the latter the small iron trap-doors which cover the receptacles for greasing the axles, restore whatever quantity has been exhausted, and then, closing with a dexterous snap the little unctuous chamber over which they preside, they proceed to the next tallow-box; and thus, while the buffer-rods of the whole train are being comfortably cleaned and greased, the glistening axles of the carriages are simultaneously fed with luxurious fat. *Thirdly*, while these two operations are proceeding in the lower region, at about the same rate two others are progressing, one inside the carriages and the other on their roofs; for on the arrival of every passenger-train, the carriage "*searcher*," also "beginning at the end," enters every carriage, lifts up first all the stuffed blue seats, next the carpet, which he drops in a heap in the middle of the carriage, and then, inquisitively peeping under the two seats, he leaves the carriage, laden with whatever article or articles may have been left in it, to continue his search throughout the train. The inconceivable number and variety of the articles which he collects we shall shortly have occasion to notice. *Fourthly*, above the searcher's head, on the roof, and following him very closely in his course, there "sits up aloft" a man called a "*strapper*," whose sole duty it is, on the arrival of every train, to inspect, clean, shampoo, and refresh with cold-drawn neat's-foot oil the luggage-straps, which, in consequence of several serious accidents that have occurred from their breaking, are now lined inside with strong iron wire. It is the especial duty of this inquisitor to condemn any straps that may be faulty, in order that they may be immediately replaced.

As soon as these four simultaneous operations are concluded, directions are given by the station-master to remove the up-carriages from their position, that the rails may be clear for the arrival of the next train. At this word of command a pilot-engine, darting from its lurking place like a spider from its hole, occasionally hisses up to the rear of the train, and drags it off bodily into a siding. The usual mode, however, of getting an in-train out of the way is by the assistance of various unnoticed turn-tables, upon which portions of it are standing. By these simple contrivances the carriages, after being unhooked from

each other, are rapidly carried off into the sidings, where they are arranged, according as they may afterwards be required, among the five sets of rails which lie between the opposite platforms of the arrival and departure trains. No sooner, however, do they reach this haven, than, *fifthly*, a large gang of strong he-housemaids, clattering towards them in wooden shoes and in leather leggings rising above their bony knees, are seen advancing; some with mops in their hands, others with large chamois leathers, while others are carrying on their shoulders a yoke, from which are suspended *in equilibrio* two pails. From pipes on each side of these five sets of rails water is immediately drawn off, and the busy operation of washing then begins. Half a dozen dusty, dirty-faced, or rather dirty-bodied, carriages are simultaneously assailed on each of their sides by wet mops flying up, down, and around in all directions. The wielders of these, be it noticed, are so skilful in their vocation, that, while they are talking to their "pailers," they with great velocity continue to mop round the wood-work of the various-shaped plate-glass windows just as vigorously and as accurately as if they were looking at them; indeed, it is evident that they know the position of railway-carriage doors, windows of all forms, handles, steps, &c., so accurately, that they could mop a coach clean in the dark;—and probably they often go through these motions when they are asleep, just as King Richard III. in his dream called for his horse and for linen bandages—just as the sleeping orator ejaculates portions of his last speech—and just as an equally tired outstretched fox-hound during the night occasionally convulsively kicks with his uppermost hind leg and yelps aloud when he thinks of the view he got of Renard as he first gallantly broke away from —— gorse. It may possibly not be known to some of the most fashionable of our readers that among "moppers" there exist the same gradations which so distinctly separate other classes of society. A "first-class mopper" would on no account demean himself by mopping a second-class carriage, and in like manner a "second-class mopper" only attains that distinction when he has for a sufficient length of time been commissioned to mop horse-boxes and common luggage-trains.

After the passenger-carriages are all washed and dried, they are minutely examined, *sixthly*, by one or more of the foremen of the coach department, who order off to their adjoining establishment any that may require repair. Those that remain are then visited, lastly, by "*the duster*," who enters each carriage with a cloth, a leather, a brush, and a dust-pan, with which apparatus he cleans the windows, wipes the wood-work, brushes the blue cloth seats, sides, and backs—and when this operation is concluded, the carriages are reported fit to depart, and accordingly are then marshalled into trains for that purpose.

Coach Department.

The new carriages for the southern division of the London and North-Western Railway are principally built by contract in the City by Mr. Wright, who also supplies carriages for other English railways, as well as a great number for Germany. The Company's establishment at Euston Station, which is therefore principally for the maintenance of carriages of various descriptions running between London and Birmingham, consists of a large area termed "the Field," where, under a covering almost entirely of plate-glass, are no less than fourteen sets of rails, upon which wounded or spare carriages lie until doctored or required. Immediately adjoining are various workshops, the largest of which is 260 feet in length by 132 in breadth, roofed with plate glass, lighted by gas, and warmed by hot air. In this edifice, in which there is a strong smell of varnish, and in the corner of which we found men busily employed in grinding beautiful colours, while others were emblazoning arms on panels, are to be seen carriages highly finished as well as in different stages of repair. Among the latter there stood a severely wounded second-class carriage. Both its sides were in ruins, and its front had been so effectively smashed that not a vestige of it remained. The iron-work of the guard's step was bent completely upwards, and a tender behind was nearly filled with the confused *débris* of its splintered wood-work—and yet, strange to say, a man, his wife, and their little child, who had been in this carriage during

its accident, had providentially sustained no injury! Close to this immense warehouse we found a blacksmith's shop seventy-five feet square, lighted from the roof with plate-glass, containing in the centre a large chimney, around which there were simultaneously at work fourteen forges, blown by a steam-engine of seventeen-horse power, which works machinery in two other shops. As, however, we shall have occasion to describe the Company's coaching establishment at Crewe, we will abruptly take leave of the details before us.

CHAPTER V.

LOST LUGGAGE OFFICE.

AT a short distance from the terminus of the up-trains there is a foundling-office, termed the Lost Luggage Office, in which are received all articles which the passengers leave behind them, and which on the arrival of every train are brought by the Company's "searcher" to this office. The superintendent on receiving them records in a book a description of each article, stating on what day, by what train, in what carriage it arrived, and by whom found. All luggage bearing an address is kept about forty-eight hours, and, if during that time no one calls for it, it is then forwarded by rail or other conveyance to its owner. In case it bears no address, if not inquired after, it is after a month opened; and if any clue to the owner can be found within, a letter is addressed to him. If no clue be found, the property is kept about two years, and has hitherto been then sold by auction in the large coach-factory to the Company's servants—a portion of the proceeds being handed over to the sick-fund for persons who have been hurt in the service, and the remainder to "the Friendly Society" among the men. It having, however, been ascertained that a few of the Railway men who had spare cash purchased the greater portion of these articles, it has, we understand, very lately been determined henceforward to sell the whole of this property by auction *exclusively to the public;* and as the Company's servants are not allowed to be purchasers, they can no longer derive any benefit whatever from lost property, which must often be of inestimable value to its owner, and which they therefore should have no interest, direct or indirect, in concealing from him.

A second ledger, entitled "*Luggage Inquiry Book,*" is kept in this office, and, if the articles therein inquired after have not

been brought in by the searcher, copies of the description are forwarded to each of the offices where lost luggage is kept; for, by the Company's orders, all luggage found between Wolverton and London is without delay forwarded to the latter station, all between Wolverton and Birmingham to Birmingham, and so on.

It is possible, however, that the above orders may not have been attended to, and therefore, as a last resource, the superintendent of the Lost Luggage Office at Euston Station applies to the manager of the Railway Clearing House, who writes to 310 stations on forty-seven lines of rails to inquire after a lost article, be it ever so small, and if it be at none of these stations a letter is then addressed to the owner, informing him that his lost property *is not on the railway*.

In the office in which these ledgers and letter-books are made up are to be seen on shelves and in compartments the innumerable articles which have been left in the trains during the last two months, each being ticketed and numbered with a figure corresponding with the entry-book in which the article is defined. Without, however, describing in detail this property we will at once proceed to a large pitch-dark subterranean vaulted chamber, warmed by hot-air iron pipes, in which are deposited the flock of lost sheep, or, without metaphor, the lost luggage of the last two years.

Suspended from the roof there hangs horizontally in this chamber a gas-pipe about eight feet along, and as soon as the brilliant burners at each end were lighted the scene was really astounding. It would be infinitely easier to say what there is not, than what there is, in the forty compartments like great wine-bins in which all this lost property is arranged. One is chokefull of men's hats, another of parasols, umbrellas, and sticks of every possible description. One would think that all the ladies' reticules on earth were deposited in a third. How many little smelling-bottles—how many little embroidered pocket-handkerchiefs—how many little musty eatables and comfortable drinkables—how many little bills, important little notes, and other very small secrets each may have contained, we felt that we would *not for the world* have ascertained; but when we gazed at the

enormous quantity of red cloaks, red shawls, red tartan-plaids, and red scarfs piled up in one corner, it was, we own, impossible to help reflecting that surely English ladies of all ages who wear red cloaks, &c., must in some mysterious way or other be powerfully affected by the whine of compressed air, by the sudden ringing of a bell, by the sight of their friends—in short, by the various conflicting emotions that disturb the human heart on arriving at the up-terminus of the Euston Station; for else how, we gravely asked ourselves, could we possibly account for the extraordinary red heap before us?

Of course, in this Rolando-looking cave there were plenty of carpet-bags, gun-cases, portmanteaus, writing-desks, books, bibles, cigar-cases, &c.; but there were a few articles that certainly we were not prepared to meet with, and which but too clearly proved that the extraordinary terminus-excitement which had suddenly caused so many virtuous ladies to elope from their red shawls—in short, to be all of a sudden not only in "a bustle" behind, but all over—had equally affected men of all sorts and conditions.

One gentleman had left behind him a pair of leather hunting-breeches! another his boot-jack! A soldier of the 22nd regiment had left his knapsack containing his kit! Another soldier of the 10th, poor fellow, had left his scarlet regimental coat! Some cripple, probably overjoyed at the sight of his family, had left behind him his crutches!! But what astonished us above all was, that some honest Scotchman, probably in the extasy of suddenly seeing among the crowd the face of his faithful *Jeanie*, had actually left behind him the best portion of his bagpipes!!!

Some little time ago the superintendent, on breaking open, previous to a general sale, a locked leather hat-box, which had lain in this dungeon two years, found in it, under the hat, 65*l.* in Bank of England notes, with one or two private letters, which enabled him to restore the money to the owner, who, it turned out, had been so positive that he had left his hat box at an hotel at Birmingham that he had made no inquiry for it at the railway-office.

CHAPTER VI.

PARCEL DELIVERY OFFICE.

BESIDES what is termed "the goods traffic," or the conveyance of heavy goods in luggage-trains, the London and North-Western Railway Company have for some time undertaken to forward by their passenger-trains, to the various stations on as well as beyond their lines, light parcels, for the conveyance and delivery of which, charges, of which the following are a sample, are made:—

For parcels under 12 lbs. weight:—	*s.*	*d.*
From London to any part of Birmingham and *vice versâ*	1	0
For distances under 160 miles	1	6
,, ,, 210 miles	2	0
From London to Durham, Carlisle, or Newcastle .	3	0
From London to Edinburgh or Glasgow . . .	4	0

The above charges include porterage and delivery of the parcels. In London, however, the delivery is limited to within three miles of the General Post-office, or say six miles from Euston Square.

The mode in which the business of this department is conducted at Euston Station is briefly as follows:—

The superintendent of the department sits in an elevated room, the sides of which being glazed enable him to look down on his right and left into two offices, both of which communicate on the south with the street by which parcels arrive from or depart to various parts of the metropolis, and on the north side with a branch railway leading into the main line. The floor of one of these two offices is generally covered with baskets, brown-
er parcels of all sizes, game, triangular boxes of wedding-
d other articles, which have just arrived by rail from all

parts of England, Ireland, and Scotland; that of the other with a multitude of parcels to be forwarded by rail to similar destinations. In the daytime the down parcels are despatched from the office in the break-waggons of various passenger-trains, and the following locked-up vans laden with small parcels are also forwarded every night:—

2 vans for	Birmingham,	1 van for	Newcastle,
1 ,,	Manchester,	1 ,,	Derby,
1 ,,	Liverpool,	1 ,,	Nottingham.
1 ,,	Carlisle and Lancaster,		

The number of parcels thus conveyed to and from London and the North amounted, in the year 1847, to 787,969, and in the year 1848 to 774,464; of the latter number it appears that only two were lost. The manner in which all these little parcels are circulated throughout the country is as follows:—

As soon as the empty railway vans arrive by the branch-rail close to the north side of the parcels-office, a porter, who, assisted by his comrades, has for some time previously been arranging the parcels into heaps according to their respective destinations, commencing with one set of them and rapidly taking up parcel after parcel, exclaims in a loud monotonous tone, easily enough set to music, inasmuch as it is exactly the middle note of a stout porter's voice, and which never varies for a moment during the whole operation—

"Now *Leighton*.

"A paper for Hancock, of——, light.

"A basket for Wagstaff, of——, out 8*d*., light.

"A box for Tomkins, of——, weighs (he puts it into an index-scale at his right hand, and in about three seconds adds) 26 pounds.

"A paper for Jones, of——, out 4*d*.

"Now *Leamington*.

"A paper for S. on Avon (the porter never says *Stratford*) for——, light," &c. &c.

As fast as this chanting porter drawls out his facts the chief clerk indelibly records them, convulsively snatching up at each change of station the particular book of entry which belongs to

it. Another clerk at each exclamation hands over to a porter a bill for the cost of conveyance, which he pastes to every parcel. For all articles declared by the first porter to be "*light*," by which he means that they do not exceed twelve pounds weight—(by far the greater number are of this description)—the charge on the paper to be affixed is ready printed, which effectually prevents fraud; but where the weight *exceeds* twelve pounds, or where any sum has been paid out, the charges are unavoidably inserted in ink. The velocity with which all these little parcels are booked. weigh-billed, placed into hand-trucks, wheeled off to their respective vans, packed, locked up, and then despatched down the little branch-rail to the main line, on which is the train ready to convey them, is very surprising. While witnessing the operation, however, we could not help observing that the Company's porters took about as much notice of the words "Keep this side uppermost," "With care," "Glass," "To be kept very dry," &c., as the Admiralty would to an intimation from some dowager-duchess that her nephew, who is about to join the Thunderer as a midshipman, "has rather *a peculiar constitution*, and will therefore require for some years *very particular* CARE."

During Christmas week the number of railway parcels that flow into and ebb out of London is so enormous, that extra accommodation, as well as preparations, are necessary for their reception and despatch; and as we chanced to arrive from the country at Euston Station on Saturday the 23rd of December last, we will endeavour briefly to describe the scenes which for a very few minutes we stopped to witness.

A considerable portion of the space usually allowed for the disembarkation of the passengers arriving by the up-trains had been cut off by a lofty partition, or, as it is now-a-days termed, a barricade, behind which, instead of red republicans armed with loaded muskets, we were exceedingly happy to find nothing but phalanxes, solid squares, columns, and pyramids of small parcels, the destinations of which in large letters were chalked on consecutive compartments of the north wall of the Euston *story, as follows*:—

"OVER THE WATER." "FINSBURY."
"STRAND." "SQUARES." "CLERKENWELL."
"ISLINGTON." "KINGSLAND."
"CAMDEN TOWN."
"CITY." "WEST END."
"WESTMINSTER."
"PIMLICO."

As soon as we had rapidly glanced over the tarpaulin-covered-in arrangements above described, which had been made for the reception of parcels *for* London, we hurried across the five sets of rails that separate the platforms of the in and out trains to the "Parcels Delivery Office," both departments of which we found had been exclusively devoted for the week to the reception and despatch of parcels *from* London to the country. On the floor of each of the offices we have already described we saw piled to a considerable height masses of parcels, which it was evident could scarcely be despatched as rapidly as they were arriving. The clerks, the assistants, as well as the extra persons who had been engaged, all appeared more or less exhausted. The accountant—the recording angel of the establishment—looked deadly pale, while the voices of the chanting porters were, to a pitiable degree, weaker and fainter than when we had last heard them; indeed, the whole establishment had evidently been overwhelmed with parcels which the Company's servants were still collecting, receiving, lifting, driving, wheeling, turning, twisting, weighing, pasting, labelling, and hallooing at, and yet, notwithstanding the rapidity with which they were despatched by rails, vans, waggons, carts, and busses, they were arriving, if possible, faster than ever!

Now, after this afflicting description of the plague of parcels which during Christmas week annually infests and infects the Euston Station, our readers will, no doubt, feel somewhat alarmed when we state that we propose to inform them in detail of the contents of each!

The job, however, is easily performed, for in these parcels

there are neither gold, silver, jewels, pictures, nor books—they contain neither covering for the body nor consolation for the mind—they belong neither to the vegetable nor to the mineral kingdom—in short, they are simply composed of good, plain, honest eatables, bequeathed by British hearts, addressed by British hands to British stomachs of all classes of society.

But as our arterial blood is of one colour, while that which returns through our veins is of another, so is there a most remarkable difference in the character of these flowing and ebbing parcels: all those which have come *into* London being either deceased turkeys or game, while the outgoing or outward-bound parcels are, with scarcely an exception, composed of barrels of live oysters, several of which are accompanied by a good heavy basket of fish. The number of barrels thus despatched from Euston Station within twenty-four hours amounted to 5009, and, as a hundred oysters are usually packed in each barrel, it is strange to think of half a million of "natives" leaving London in one day for the express purpose of wishing "a merry Christmas and a happy new year" to those whose hares, pheasants, partridges, rabbits, turkeys, and chickens have inanimately come to the metropolis on the very same day on the very same errand! To the above "bills of fare" we may add, that during last Christmas week no less than 450 waggons of live cattle arrived at Camden Station within the space of twenty-four hours.

CHAPTER VII.

THE LOCOMOTIVE ENGINE.—CAMDEN.

CONSIDERING how many fine feelings and good feelings adorn the interior of the human heart, it is curious to observe with what facility we can put them all to sleep, or, if they won't sleep, stupify ourselves, at any moment when it becomes inconvenient to us to listen to their friendly admonitions. All the while mailing, coaching, and posting were in fashion, every man's countenance beamed—every person's tongue gabbled freely as it described not only "*the splendid rate*" (say ten miles an hour) at which he had travelled, but the celerity with which no sooner had the words "*First turn-out!*" been exclaimed by the scout, who vanished as soon as he had uttered them, than four horses in shining harness had appeared half hobbling half trotting from under the archway of the Red Lion, the Crown, or the Three Bells, before which the traveller had from a canter been almost suddenly pulled up, to receive various bows, scrapes, and curtsies from the landlord and his rosy-faced cap-beribboned wife. But, although we could all accurately describe our own enjoyments, and, like Johnson, expatiate on "the delightful sensations" we experienced in what we called *fast travelling*, who among us ever cared to ascertain, or even for a single moment to think of, the various arrangements necessary for watering, feeding, cleaning, and shoulder-healing all the poor horses whose "brilliant" performances we had so much admired? Whether they slept on straw or on stones—indeed, whether they slept at all—what was their diet—what, if any, were their enjoyments—what were their sufferings—and, lastly, how and where they eventually died—it would have been deemed exceedingly vulgar to inquire; and so, after with palpitating flanks and panting nostrils they had once been unhooked from our splinter-bars,

"Where they went, and how they fared,
No man knew, and no man cared!"

In a similar way we now chloroform all kindly feelings of inquiry respecting the treatment of the poor engine-drivers, firemen, and even of the engine that has safely conveyed us through tunnels and through storms at the rate of thirty, forty, and occasionally even fifty miles an hour—

"Oh no! we never mention them!"

and in fact scarcely do we deign to look at them. Indeed even while in the train, and most especially after we had left it, we should feel bored to death by being asked to reflect for a moment on any point or any person connected with it. We have therefore, we feel, to apologise at least to some of our readers for intruding upon them, in bringing "betwixt the wind and their nobility" the following uninteresting details.

As soon as an engine has safely dragged a passenger-train to the top of the incline at Camden Station, at which point the coupling-chains which connect it with its load are instantly unhooked, it is enabled by the switchman to get from the main line upon a pair of almost parallel side rails, along which, while the tickets are being collected, it may be seen and heard retrograding and hissing past its train. After a difficult and intricate passage from one set of rails to another, advancing or "shunting" backwards as occasion may require, it proceeds to the fire-pit, over which it stops. The fireman here opens the door of his furnace, which by a very curious process is made to void the red-hot contents of its stomach into the pit purposely constructed to receive them, where the fire is instantly extinguished by cold water ready laid on by the side. Before, however, dropping their fire, the drivers are directed occasionally to blow off their steam to clean; and we may further add that once a-week the boiler of every engine is washed out to get rid of sediment or scale, the operation being registered in a book kept in the office. After dropping his fire, the driver, carefully taking his fire-bars with him, conducts his engine into an immense shed or engine-stable 400 feet in length by 90 in breadth, generally half full of loco-

motives, where he examines it all over, reporting in a book what repairs are wanting, or, if none (which is not often the case), he reports it "*correct.*" He then takes his lamps to the lamp-house to be cleaned and trimmed by workmen solely employed to do so, after which he fetches them away himself. Being now off duty, he and his satellite fireman go either to their homes or to a sort of club-room containing a fire to keep them warm, a series of cupboards to hold their clothes, and wooden benches on which they may sit, sleep, or ruminate until their services are again required; and here it is pleasing to see these fine fellows in various attitudes enjoying rest and stillness after the incessant noise, excitement, and occasional tempests of wind and rain, to which—we will say nothing of greater dangers—they have been exposed.

The duties which the engine-driver has to perform are not only of vital importance, but of a nature which peculiarly illustrates the calm, unpretending, bull-dog courage, indigenous to the moist healthy climate of the British Isles. Even in bright sunshine, to stand—like the figure-head of a ship—foremost on a train of enormous weight, which, with fearful momentum, is rushing forward faster than any race-horse can gallop, requires a cool head and a calm heart; but to proceed at this pace in dark or foggy weather into tunnels, along embankments, and through deep cuttings, where it is impossible to foresee any obstruction, is an amount of responsibility which scarcely any other situation in life can exceed; for not only is a driver severely, and occasionally without mercy, punished for any negligence he himself may commit, but he is invariably sentenced personally to suffer on the spot for any accident that from the negligence of others may suddenly befall the road along which he travels, but over which he has not the smallest control. The greatest hardship he has to endure, however, is from cold, especially that produced in winter by evaporation from his drenched clothes passing rapidly through the air. Indeed, when a gale of wind and rain from the north-west, triumphantly sweeping over the surface of the earth at its ordinary rate of say sixty miles an hour, suddenly meets the driver of the London and North-Western, who has not only to withstand such an antagonist, but to dash through him, and in

spite of him to proceed in an opposite direction at the rate of say forty miles an hour—the conflict between the wet Englishman and Æolus, tilting by each other at the combined speed of a hundred miles an hour, forms a tournament of extraordinary interest.

As the engine is proceeding, the driver, who has not very many inches of standing-room, remains upon its narrow platform, while his fireman, on about the same space, stands close beside him on the tender. We tried the position. Everything, however, proved to be so hard, excepting the engine, which was both hard and hot, that we found it necessary to travel with one foot on the tender and the other on the engine, and, as the motion of each was very different, we felt as if each leg were galloping at a different stride. Nevertheless the Company's drivers and firemen usually travel from 100 to 120 miles per day, performing six of these trips per week; nay, a few run 166 miles per day—for which they are paid eight days' wages for six trips.

But to return to the engine which we just left in the engine-house. As soon as the driver has carefully examined it, and has recorded in a book the report we have described, the "foreman of the fitters" comes to it, and examines it all over again; and if anything is found out of order which, on reference to the book, the driver has not reported, the latter is reported by the former for his negligence. A third examination is made by Mr. Walker, the chief superintending engineer of the station, a highly intelligent and valuable servant of the Company, who has charge of the repairs of the locomotive department between Camden and Tring. If HE detects any defect that has escaped the notice not only of the driver, but of the foreman of the fitters, woe betide them both!

While the engine, with several workmen screwing and hammering at it, is undergoing the necessary repairs, we will consider for a moment a subject to which Englishmen always attach considerable importance, namely, its victuals and drink, or, in other words, its coke and water. There is at Camden Station a coke-factory composed of eighteen ovens, nine on each side, in which coal after being burnt for about fifty hours gives nearly two-thirds of its quantity of coke. These ovens produce about 20 tons of coke per day; but, as 50 tons per day are required for the

Camden Station alone, the remaining 30 tons are brought by rail all the way from Newcastle. Indeed, with the exception of fifty ovens at Peterborough, the whole of the coke required annually for the London and North-Western Railway, amounting to 112,500 tons, of an average value of 1*l.* per ton, comes from the Northern Coal-fields. For some time there were continual quarrels between the coke suppliers and receivers, the former declaring that the Company's waggons had been despatched from the North as soon as loaded, and the latter complaining that they had been unnecessarily delayed. A robin-redbreast settled the dispute, for, on unloading one of the waggons immediately on its arrival at Camden Station, her tiny nest with three eggs in it minutely explained that the waggon had *not* been despatched as soon as loaded.

In order to obtain an ample supply of water for their engines, the Company at considerable expense sank at Camden an Artesian well 10 feet in diameter and 140 feet deep. The produce of this well, pumped by a high-pressure steam-engine of 27-horse-power into two immense cisterns 110 feet above the rails at Euston Square, supplies all the Camden Station, all the Company's houses adjoining, the whole of the Euston Station, as well as the Victoria and Euston Hotels, with most beautiful clear water; and yet—though every man who drinks it or who shaves with it admires it, and though every lady who makes tea with it certifies that it is particularly well adapted for that purpose—strange to say, it disagrees so dreadfully with the stomachs of the locomotive engines—(who would ever suspect *them* to be more delicate than our own?)—that the Company have been obliged, at great inconvenience and cost, to obtain water for them elsewhere. The boilers of the locomotives were not only chemically liable to be incrusted with a deposition of the unusual quantity of soda contained in the Artesian-well water at Camden Station; but, not even waiting for this inconvenience, the engine without metaphor spit it out—ejecting it from the boiler with the steam through the funnel-pipe, a well-known misfortune termed by engineers "*priming*."

As much time would be required for each travelling engine to

get up its steam *ab initio*, a coke-furnace has been constructed at Camden Station to hasten the operation. Here nine men during the day, and the same number throughout the night, are continually employed to heat coke, which by means of iron shovels is to be delivered red-hot into the engines' furnaces.

These preparations having been made, the driver's duties are as follows:—

On leaving the shed in the morning the engine, after having been heated at the coke-furnace, is conducted on to a great turn-table 40 feet in diameter, which twists it towards a set of rails leading to the water-crane, where it imbibes at one draught about a thousand gallons of cold water, which, under ordinary circumstances, will enable it to draw its train about 40 miles; although in slippery weather, when the wheels revolve *on*, instead of *along*, the rails, it of course would not carry it so far. It then proceeds to the coke-shed, an enclosure 210 feet by 45 feet, capable of holding 1500 tons, for its proper supply of coke, namely, 1 ton—a goods-engine usually devouring 2½ tons.

The driver, leaving his engine in charge of his fireman, now proceeds to the office, where he signs his name in a book, the object being that it may be observed whether or not he is perfectly sober. From the chief clerk he receives his coke and time ticket, upon which, at every station, he has to record whatever time he may have lost up to that point; and when his chronometer is wound up, and set to the proper time, he is then considered to be ready for his journey.

The gigantic power of the locomotive engines hourly committed to the charge of these drivers was lately strangely exemplified in the large engine-stable at the Camden Station. A passenger-engine, whose furnace-fire had but shortly been lighted, was standing in this huge building surrounded by a number of artificers, who, in presence of the chief superintendent, were orking in various directions around it. While they were all ılly occupied, the fire in the furnace, by burning up faster ın was expected, suddenly imparted to the engine the breath life; and no sooner had the minimum of steam necessary to ove it been thus created, than this infant Hercules not only

walked *off*, but without the smallest embarrassment walked *through* the 14-inch brick wall of the great building which contained it, to the terror of the superintendent and workmen, who expected every instant that the roof above their heads would fall in and extinguish them! In consequence of the spindle of the regulator having got out of its socket, the very same accident occurred shortly afterwards with another engine, which, in like manner, walked through another portion of this 14-inch wall of the stable that contained it, just as a thorough-bred horse would have walked out of the door. And if such be the irresistible power of the locomotive engine when feebly walking in its new-born state, unattended or unassisted even by its tender, is it not appalling to reflect what must be its momentum when, in the full vigour of its life, it is flying down a steep gradient at the rate of 50 miles an hour, backed up by say 30 passenger-carriages, each weighing on an average 5½ tons? If ordinary houses could suddenly be placed on its path, it would, passengers and all, run through them as a musket-ball goes through a keg of butter; but what would be the result if, at this full speed, the engine by any accident were to be diverted against a mass of solid rock, such as sometimes is to be seen at the entrance of a tunnel, it is almost impossible to calculate, or even to conjecture. It is stated by the Company's superintendent, who witnessed the occurrence, that some time ago, an ordinary accident happening to a luggage-train near Loughborough, the waggons overrode each other until the uppermost one was found piled 40 feet above the rails!

At Camden Station there are every day five spare or pilot engines, with their steam up, ready for assisting a train up the incline, or for any special purposes that may be required.

The average cost of the locomotive engines and tenders, which, for the rails between London and Birmingham, are usually purchased by the Company from makers at Manchester, Warrington, and Liverpool, is—

Cylinder 15-inch diameter	£1,950	0	0
„ 16 „	2,113	10	0
„ 18 „	2,500	0	0

The tenders cost 500*l.* each.

CHAPTER VIII.

GOODS DEPARTMENT.

THE duties of this department, which forms one of the most important establishments at Camden Station, may very briefly be elucidated. It appears from returns lying before us, that during the six months ending the 26th of August last there entered and departed from Camden Station alone 73,732 railway waggon-loads of goods! Now in the annals of political economy there can perhaps scarcely exist a more striking exemplification of the extraordinary extent to which the latent resources of a great country may be developed by diminishing the friction, or, without metaphor, by lowering the tolls of its goods-traffic, than the fact that, notwithstanding the enormous amount thus conveyed along the London and North-Western rails, the quantity carried along the Grand Junction Canal, which meanders alongside its powerful antagonist, instead of having been drained, as might have been expected, to zero, has, from the opening of the railway in 1836 up to the present period, actually increased as follows:—

	Tons.
Average amount of goods annually moved on the Grand Junction Canal during the three years prior to the opening of the London and Birmingham Railway in 1836	756,894
Average amount of ditto annually moved during the twelve years subsequent to 1836	1,039,333
Amount moved in 1847	1,163,466

Besides the innumerable arrangements necessary for the conveyance along their rails of the number of waggon-loads of goods we have stated, the Company undertake the vexatious and intricate business of collecting and delivering these goods from and to all

parts of London, as also throughout the various towns on their line, excepting Liverpool, where the collection and delivery of goods is otherwise arranged. The number of letters on business received by the branch of this department at Camden Station only, averages 300 per day.

For the collection, loading, unloading, and delivery of a certain portion of the merchandise conveyed by the Company on their rails, the Board of Directors have, we think with great prudence, availed themselves of the practical knowledge and experience of Messrs. Pickford and of Messrs. Chaplin and Horne, whom they have engaged as their agents at Camden Station—the Company's superintendent there marshalling and despatching all luggage-trains, arranging the signals, and making out the weigh-bills, &c. The undertaking is one of enormous magnitude; for besides immense cargoes of goods in large packages, an inconceivable number of small parcels are sent from Birmingham, Wolverhampton, Sheffield, &c. to numberless little retail shopkeepers in London, who are constantly requiring, say a few saucepans, kettles, cutlery, &c.; and when it is considered that for the collection, conveyance, and delivery of most of these light parcels 1*s.* only is charged, and, moreover, that for the conveyance of a small parcel by the Company's goods-trains from say Watford to Camden Station, to be there unloaded into store, thence reloaded into and transported by a spring waggon to almost any street and house in London, or to the terminus of any railway-station to which it may be addressed, the charge is only 6*d.*, it is evident that a great deal of attention and skill are necessary to squeeze a profit from charges which competition has reduced to so low a figure.

At, and for some time after, the commencement of railway traffic, it was considered dangerous to convey goods by night. They are now, however, despatched from Birmingham at 8·45 P.M., to arrive at Camden Station at 3½ in the morning. Goods from London are despatched at 9 in the evening, at midnight, at 12½, at ¼ before 1, at 3, and at 5 in the morning. In the day they are despatched at 12·40, at 1·15, at 2·6, and at 6½; and such regularity is attained, that packs of cotton, linen, and woollen

goods from Manchester are usually delivered in London almost with the regularity of letters. An immense quantity of fish from Billingsgate, and occasionally as much as 20 tons of fruit from Covent Garden market, are injected into the country by the midday train: indeed the London wholesale dealers in these articles do not now fear receiving too great a supply, as, whatever may be their surplus, the railway is ready to carry it off to the manufacturing districts—Manchester alone swallowing almost any quantity; besides which, large quantities of fruit are conveyed by rail as far as Glasgow. Many tons of meat in hampers, and oftentimes a flock of a hundred dead sheep, wrapped up only in cloths, are also despatched from the country to the London market.

Without tiring our readers with minute details, the following is a rough outline of the mode in which the goods-traffic is conducted.

As soon as an up luggage-train arrives at Camden Station, its loaded waggons of merchandise, which are placed under the care of the Goods-department Superintendent as soon as they arrive, are, under his directions, drawn by horses along a variety of branch-rails to a certain point, where they are left by the superintendent in the open air, from which moment Messrs. Pickford and Messrs. Chaplin and Horne—to whom the different waggons are respectively addressed, and between whom a wholesome competition exists, highly advantageous to the public—are held responsible by the Company for fire or accident of any sort; in short, for their safe delivery. The waggons thus deposited by the superintendent, solely under the canopy of heaven, are instantly approached by drivers and horses belonging to the two competing agents, who with great cleverness, by repeatedly twisting them on turn-tables, and then by drawing them along an apparent labyrinth of rails, conduct each species of goods to its own store, where, by experienced porters, it is immediately unloaded and despatched by spring waggons to its destination.

As regards the down-trade, the business transacted in this department, although apparently complicated, is very admirably

arranged. The spring waggons and carts of the Company's agents, like bees in search of honey, with extraordinary intelligence migrate in all directions to the various localities of the metropolis in search, piecemeal, of that enormous traffic, large and small, which by every diurnal pulsation of the heart of London is projected into our manufacturing districts, which in return send back to the metropolis very nearly the same amount. Every waggon-load of merchandise thus obtained, as well as every boat-load of goods (for the Company have also at Camden Station a branch water-communication leading into the Regent's Canal), is either carted at once to the particular storehouse to which it belongs, to be thence reloaded into railway vans, or it is brought to "*The General Receiving Shed*" either of Messrs. Pickford, or of Messrs. Chaplin and Horne; and to prevent mistakes, all invoice-forms and truck-labels for the former firm are printed in black, those for the latter in red. In these enormous receptacles goods "*coming in*" are arranged on one side, those "*going out*" on the other. In Messrs. Pickford's receiving shed, which is 300 feet in length by 217 in breadth, there are in operation, for the purpose of rapidly loading and unloading goods—

24 steam-cranes,
21 wooden cranes,
1 steam-doller or lift,
1 travelling-crane on the roof,
1 steam-capstan for hauling trucks along rails to the various loading bays.

We observed also at work 4 steam hay-cutters, which cut 200 trusses in four hours, and 1 steam hay-cleaner. The above machines are worked simultaneously by an engine of 16-horse power, which also raises from an Artesian well, 380 feet deep, water, which is given warm to 222 horses in adjoining stables. These horses are all named, and branded with a number on their hoofs.

In the general receiving-shed of Messrs. Chaplin and Horne there are also a series of cranes, with large stables full of horses

that work about twelve hours a-day; the "Weights of Goods allowed to be taken by them in each Vehicle" being as follows:—

From Camden.

	Tons. Cwts.		Tons. Cwts.	
4 Horses	. 5 0 . .	Not to exceed	. 6 0	waggons.
3 Do.	. 4 0 . .	Do.	. 4 10	vans.
2 Do.	. 3 0 . .	Do.	. 3 5	do.
1 Do.	. 1 10 . .	Do.	. 1 15	carts.

By the very great powers committed by the Company to their two agents, 50 waggon-loads of merchandise, collected and brought by spring-waggons to Camden Station, have often, within two hours, been despatched by the superintendent to the manufacturing districts. During the day, as fast as the spring-waggons arrive their contents are unloaded, and either left on the covered platform of the building or ranged around the walls in large compartments, labelled "Glasgow," "Birmingham," "Manchester," "Leicester," "Nottingham," "Coventry," &c.; and as on the great square of Valetta at Malta one sees congregated the costumes of almost every merchant upon earth, so do these receiving-sheds display goods and chattels of almost every description. Here lies a waggon-load of beer from Chester,—there another of sugar-loaves, in blue paper, for Northampton,—of groceries for Buckingham,—cheeses, millinery, and gas-pipes for Peterborough,—a vanload of empty hosiery skips (baskets) to return to Leicester,—empties for Glasgow,—filberts for Birmingham, &c.: and as the goods are coming in as fast as they are going out, the colours of this kaleidoscopic scene are constantly changing. Indeed, during the short time we were ruminating on the strange chance-medley of objects before us, fourteen truck-loads of goods were unladen, and eight spring-waggons loaded and despatched.

The amount of business transacted in each of these great receiving-sheds every evening, from seven till about ten o'clock, is quite astonishing. On Messrs. Pickford's great elevated platform, which at that time is laden with goods of all descriptions, several clerks, each protected by a sort of rough arbour of iron rods.

and lighted by gas, are seen, in various localities, sitting before little desks, towards which porters from all directions are wheeling, on trucks, different articles which have just been unloaded from a series of spring-vans, the bottoms of which are nearly on a level with the platform. The drivers of these carriages, entering the building at a large gate, twist, turn, and then back their horses with a dexterity which an unpractised person would think it impossible for men and horses to attain: "*Now then!*" and "*All right!*" being almost the only vociferations to be heard. As fast as the goods can be unladen from the spring-waggons to the platform, a porter lustily calls out the address on each bale or parcel, which is actively registered by a clerk. These invoices are then briskly sent across to the other side of the platform, in order that each article enumerated therein, when reloaded—as it almost immediately is, into railway waggons—may be ticketed off, to ascertain whether every package taken in at the receiving side of the platform has *bonâ fide* been safely despatched from the other.

Until the visitor to this extraordinary nocturnal scene has had some time first to recover his composure, and then to observe, analyse, and reflect on the various arrangements simultaneously in operation before him, the picture altogether is really astounding. For from one side of the platform a set of active porters are centripedally wheeling from different spring-waggons innumerable packages to the recording clerks, as eagerly as from these clerks (whose duty it is to record the weight of every article, and to affix to it the Company's printed charge for conveyance to its address) other porters, equally active, are centrifugally wheeling other packages to various railway vans, which, as fast as they can be filled, are drawn away from the despatching side of the platform, and immediately replaced by empty ones. One set of porters are wheeling to a recording clerk a waggon-load of raw silk, valued at 9000*l.*, from China, which, *viâ* the South-Western Railway, has just arrived from Southampton to go to Macclesfield to be manufactured; another set, Russia tallow, in casks; others, draperies; another set, yarns for Gloucester; one porter has on his truck a very small but heavy load of iron or lead;

another, with comparative ease, is wheeling through the crowd a huge wool-bag, large enough to contain, if properly packed, a special jury. Here comes a truck of mustard, in small casks, followed by another full of coffee; there goes a barrow-load of drugs—preceding a cask of spirits, which, to prevent fraud, has just been weighed, tapped, gauged, and sampled; also several trucks full of household furniture; the family warming-pan being tacked round the body of the eight-day clock, &c. This extraordinary whirl of business, set to music by the various noises proceeding from the working of the steam-cranes, steam-doller, steam-capstan, common cranes, and other machinery above the platform—from the arrival, turning, backing, and departure of spring-waggons beneath it—from the rumbling of porters' trucks crossing the platform, as also of the railway vans as, laden with goods, they are successively rolled away—forms altogether, we repeat, a scene which, though rarely visited, is astounding to witness, and which, we are sensible, we have but very faintly described.

But, besides the amount of business above mentioned daily transacted in each of the agents' great "receiving-sheds," there are nine other sheds, in which, throughout the day, and especially at night, the same process on a smaller scale is going on. Close to these stores there is also a water-dock for iron and heavy goods to be shipped for the Thames. The carting establishments of Messrs. Pickford and Chaplin for the collection and delivery of their share only of the goods-traffic—for the Company have establishments of their own for loading and unloading at every station except London—would appear to any foreigner unacquainted with the modest and unassuming powers with which the mercantile business of England is quietly transacted, to be incomprehensible and almost incredible. For instance—

Messrs. Pickford's establishment, on account of the London and North-Western Railway, is as follows:—

Clerks.	Porters.	Horses.	Vans.	Waggons.	Drays.
234	538	396	82	57	25

The weights carted by Messrs. Pickford, on account of the Company, for the year ending the 30th of June last, amounted to—

	Tons.	cwts.	qrs.	lbs.
Collected	133,437	18	0	15
Delivered	139,898	19	0	5
Making a gross total of	273,336	17	0	20

Or rather more than 841 tons per day.

And yet the Company's merchandise operations at Liverpool exceed those at London in the proportion of 9 to 6½!

As soon as the two agents, at their respective receiving-sheds, have loaded their trucks, and have securely covered them with water-proof and fire-proof tarpaulins, they turn them out, labelled, into the open air, from which moment they are considered to be in the hands of the Company's superintendent of the goods-department. Accordingly, under his direction, they are immediately drawn by horses first over a weighbridge to receive their weigh-bills, and thence to a series of ten turn-tables, by which they are scattered among thirteen sets of rails, where they are marshalled into trains for their respective destinations. In this operation it is alarming to see the superintendent's horses dragging the various luggage-vans, for not only are the rails as well as the pavement between them exceedingly slippery, but as the carriages have no shafts, the poor horse has not power to stop his load, and accordingly affixed to it by his traces he trots away before it, until it appears as if he must inevitably be smashed to a sandwich between it and the carriage at rest which he is approaching; however, just before the collision between the buffers of each vehicle takes place, the dull-looking animal jumps aside, and very dexterously saves himself from annihilation. The luggage-trains thus formed are usually composed of 35, but sometimes of 70 or 90 waggons, weighing when empty about three tons each, and averaging when laden about six tons. At the rear of each of these trains there sits a guard. The Company's goods-waggons of all descriptions amount in number to 6236.

Engine Stable and Cattle Wharf.

In order to prevent the locomotive engines which draw these luggage-trains from crossing, or otherwise perilling the main passenger-line at Camden Station, there has been constructed an immense rotunda, 160 feet in diameter, lighted from the top by plates of glass nine feet in length by half an inch thick, and capable of containing twenty-four of the largest-class engines. In the centre of this great brick building there is a turn-table 40 feet in diameter, from whence the engines radiate to their twenty-four stalls, which on a large scale much resemble those constructed in a stable for hunters. The majority of these locomotives are capable of drawing 600 tons at the rate of twelve miles an hour. Each, when supplied with coke and water, with steam up ready for its journey, weighs about 50 tons. At the entrance of this building there is a pit into which, after their journey, they may drop their fire, and between the rails in each of the twenty-four stalls we observed a smaller pit to enable artificers to work beneath any engine that may require reparation. The drivers of these huge locomotives, after every journey, inspect and report in a book, as in the passenger-trains, any repairs that may be required, and the engines are thoroughly cleaned every time they come in.

At a short distance from this rotunda we observed a platform about 300 yards long, constructed for the landing of cattle, which arrive there generally on Thursdays and Saturdays from 2 P.M. till midnight. Fifty waggon-loads of bullocks, sheep, or pigs can here be unloaded at a time, and then driven into strong pens or pounds, constructed in the rear. The Company's cattle and merchandise waggons are usually painted blue, their sheep-waggons green. On the arrival of a train of cattle it is interesting

to watch a quantity of polished horns, bright eyes, streams of
and healthy black wet noses projecting above the
their respective waggons, and fatal as is the object
John Bull's metropolis, it is some consolation to
for things—they are, at all events, in ignorance

of the fate that awaits them. In disembarking the cattle, in spite of every precaution, an enfuriated Welsh or a wild Irish bullock will occasionally escape from this platform, and by roaring, jumping, and galloping, with depressed head and up-stretched tail—

> "Hereditary bondsmen! know ye not,
> Who would be free, himself must strike the blow!"—

create no small consternation as well as confusion among the green-coated pointsmen, porters, and policemen in charge of the various sets of tributary rails which flow from the waggon department into the main line. Instead, however, of attempting, as in the case of Mr. Smith O'Brien, to capture the fugitive by force, this object is effected by the simple stratagem of instantly turning loose several other black-nosed bullocks, which he no sooner sees, than, running and galloping towards the herd, he is quietly driven with them into a pen, where he appears quite to enjoy "the Union," which a few minutes ago he had so violently and so vociferously attempted to "*repale.*"

Waggon Hospital.

Among the large establishments at Camden Station is one for the maintenance and repair of the luggage-trucks and goods-carriages of the Southern District, namely, from London to Birmingham—in which alone there are 2000 luggage-waggons with a proportionate number of trucks. The construction-shop for this department, in which 129 men were at work, is 437 feet in length by 64 in breadth. With its sideways it is capable of containing and of repairing at one time 100 carriages; the average number in hospital being, however, from 60 to 70. In the smiths' shop we observed working at once 14 common forges blown by steam, also four portable ones. In locked-up vaulted stores adjoining there was lying, besides deals and Memel planks, 4000*l.* worth of oak timber in scantlings of the various sizes required, each lot ticketed with its dimensions. It is surprising to observe the quantity of iron and oak timber used in the construc-

tion of the Company's luggage-trucks. Nevertheless, although they are built infinitely stronger in proportion than any ship (for their oak stancheons, being straight instead of curved, when they come in collision strike end foremost), yet we witnessed results of accidents which were really appalling; in many cases the largest of these timbers had been splintered; indeed, in a railway smash the British oak usually either stands the shock without flinching, or, if it *does* give, shivers into atoms. Barring, however, accidents, a luggage-truck or waggon will last about twelve years.

Among the Company's goods-carriages we observed eight powder-magazines, constructed under a patent invention of the superintendent, Mr. Henson. They were covered outside with sheet iron, lined with wood, had leaden floors, and the axles were cased with hornbeam to prevent vibration. With these precautions they each safely convey 4½ tons of gunpowder through and over the sparks of fire and red-hot coals that are continually, during the progress of a train, flying from the funnel-pipe or dropping from the furnace of the engine.

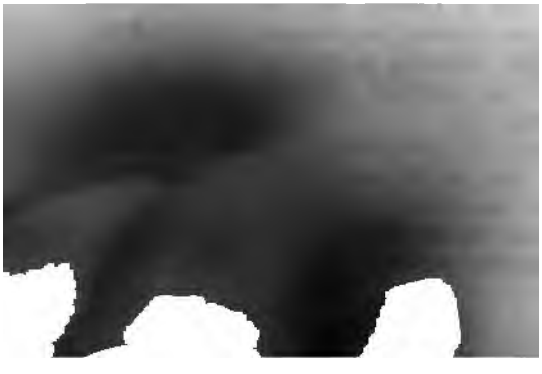
As soon as a luggage-train has been unloaded at Camden Station all the wheels of the waggons are gauged to see that there are no bent axles, and that none of the "journals," or working ends of the axles, have been heated, for they sometimes get red-hot; and we may here remark, that under heavy loads the tremendous vibration of the axles of goods-carriages during their journeys materially alters the composition of the iron, and that when the axles have once been red-hot, although after cooling they are as strong as ever, they are always particularly liable to get red-hot again, and the brass boxes amalgamating with the iron, the ends of the largest axles are occasionally wrenched off as one would break a carrot. The luggage-waggons are minutely inspected on arriving and on departing from Camden, Wolverton, and Rugby; besides which the guard hastily examines them at every station, where they are also greased if required.

The Pointsman.

Among the servants of a railway company, or rather we should say of the public, there is no one who, in his secluded station, has more important duties to attend to than "the pointsman," in charge of the switches for diverting a train from one set of rails to another. As it is of course necessary that these switches should be carefully worked and guarded by night as well as by day, there are usually appointed to each station two pointsmen, each of whom remains on duty twelve hours at a time, taking the night and day work week about. At Camden Station one of these men has fourteen switches to attend to, and at Wolverton thirteen pairs. At the latter place, to prevent intrusion and to increase precaution, the pointsman has always the signal of danger on, but on perceiving an up-train about a mile off, he shows a green flag to the Station signal-man, and does not avert that of danger until he has received answer that "all is right." In thick weather he himself works a subterranean auxiliary signal 500 yards off, showing lamps of different colours. In a fog, to prevent any train running into the station, a man is sent down the line about a mile, to affix upon the rails, every 200 yards, one of Toy and Hansom's patent fog-signals, which, exploding under the engine with the report of a small cannon, warn the driver to stop and remain where he is, until some one comes to give him orders. At Crewe Station, from whence radiate three important lines of rails, namely, on the right to Manchester, straight on to Liverpool, and on the left to Chester, there are constantly on duty three pointsmen, one of whom has seventeen pairs of points to attend to, namely, five belonging to the Chester line, one to the Liverpool, eleven to the workshops. His box stands between the Liverpool and Chester lines.

Nothing can apparently be more cheerless than the existence of these poor fellows, who, cut off from society, in all weathers and in all seasons have, in solitude, to perform duties for which no passing traveller ever thanks them, and which he probably does not even know that they perform. It is, however, providen-

tially decreed that the human heart warms under almost every description of responsibility; and, accordingly, we invariably found these pointsmen not only contented, but apparently intently interested in their important duties; indeed the flowers which we observed blooming around their little wooden habitations were not, we felt, unappropriate emblems of the happiness which naturally springs up in the heart of every man who will honestly perform the duties of his station. The Company's pointsmen have nominally not very high wages:—a gratuity, however, every twelve months is given to them, provided they cause no accident; but should one occur from their switches, no matter how small, they forfeit it:—an arrangement, we think, very cleverly conceived.



CHAPTER IX.

WOLVERTON.

FLYING by rail through green fields below Harrow Hill and thence to Watford,—stopping for a moment in a deep cutting to hear a man cry "*Tring!*" and a bell say "*Ring!*" until the passenger gets so confused with the paltry squabble that he scarcely knows which of the two competitors is vociferating the substantive, and which the verb,—we will now conduct our readers to the Station and little town of Wolverton.

As every city, village, or hamlet on the surface of the globe is usually inhabited by people of peculiar opinions, professions, character, tastes, fashions, follies, whims, and oddities, so there is always to be witnessed a corresponding variety in the allinement and architecture of their dwellings—the forms and excrescences of each often giving to the passing traveller a sort of phrenological insight into the character of the inmates. One street, inhabited by poor people, is as crooked as if it had been traced out by the drunken Irishman who, on being kindly questioned, in a very narrow lane across which he was reeling, as to the length of road he had travelled, replied, "*Faith! it's not so much the length of it as the* BREADTH *of it that has tired me!*" Another—a rich street —is quite straight. Here is a palace—there are hovels. The hotel is of one shape—the stock-exchange of another. There are private houses of every form—shops of every colour—columns, steeples, fountains, obelisks *ad infinitum*. Conspicuous over one door there is to be seen a golden pestle and mortar—from another boldly projects a barber's pole—a hatchment decorates a third—the Royal Arms a fourth—in short, it would be endless to enumerate the circumstantial evidence which in every direction proves the truth of the old saying, "*Many men, many minds.*"

To all general rules, however, there are exceptions; and certainly it would be impossible for our most popular auctioneer, if he wished ever so much to puff off the appearance of Wolverton, to say more of it than that it is a little red-brick town composed of 242 little red-brick houses—all running either this way or that way at right angles—three or four tall red-brick engine-chimneys, a number of very large red-brick workshops, six red houses for officers—one red beer-shop, two red public-houses, and, we are glad to add, a substantial red school-room and a neat stone church, the whole lately built by order of a Railway Board, at a railway station, by a railway contractor, for railway men, railway women, and railway children; in short, the round cast-iron plate over the door of every house, bearing the letters L. N. W. R., is the generic symbol of the town. The population is 1405, of whom 638 are below sixteen years of age; indeed, at Wolverton are to be observed an extraordinary number of young couples, young children, young widows, also a considerable number of men who have lost a finger, hand, arm, or leg. All, however, whether whole or mutilated, look for support to "the Company," and not only their services and their thoughts but their parts of speech are more or less devoted to it:—for instance, the pronoun "*she*" almost invariably alludes to some locomotive engine; "*he*" to "the chairman," "*it*" to the London Board. At Wolverton the progress of time itself is marked by the hissing of the various arrival and departure trains. The driver's wife, with a sleeping infant at her side, lies watchful in her bed until she has blessed the passing whistle of "the down mail." With equal anxiety her daughter long before daylight listens for the rumbling of "the 3½ A.M. goods up," on the tender of which lives the ruddy but smutty-faced young fireman to whom she is engaged. The blacksmith as he plies at his anvil, the turner as he works at his lathe, as well as their children at school, listen with pleasure to certain well-known sounds on the rails which tell them of approaching rest.

The workshops at Wolverton, taken altogether, form, generally speaking, an immense hospital or "Hôtel des Invalides" for sick and wounded locomotive engines of the Southern

District. We witnessed sixty of them undergoing various operations, more or less severe, at the same time. Among them was Crampton's new six-wheel engine, the hind wheels of which are eight feet high, weighing thirty-eight tons, and with its tender sixty tons. It is capable of drawing at the usual speed twelve carriages laden with passengers. The workshops at this station are so extensive, that it would be tedious and indeed almost impracticable to describe them in detail; we will therefore merely mention that in one of them we saw working at once by the power of an 18-horse steam-engine twelve turning-lathes, five planing-machines, three slotting-machines, two screw-bolt ditto—and, as a trifling example of the undeviating accuracy with which these contrivances work, we may state that from a turning-lathe a shaving from cold iron will sometimes continue to flow for forty feet without breaking. There are a large cast-iron foundry, a brass foundry, machines for grinding, and also for polishing; sheers for cutting, and stamps for punching cold iron as if it were pasteboard; an immense oven for heating tires of wheels; a smith's shop containing twenty-four forges, all of which were in operation at once. Two steam-engines—one for machinery, the other for pumping water for the town and offices only, for the Company's well-water here, as at Camden Station, disagrees with the locomotives. A large finishing store, in which were working by steam fifteen turning-lathes, five slotting-machines, five planing ditto, one screwing ditto, two drilling ditto, two shaving ditto. Beneath the above we entered another workshop containing sixteen turning-lathes, two drilling-machines, one slotting ditto, one screwing ditto, one nut ditto, one cylinder-boring ditto, one shaping ditto. In the great store-yard there is an hydraulic press of a power of 200 tons for squeezing wheels on to their axles, or wrenching them off. Another workshop is filled with engines undergoing repair, and adjoining it there is a large store or pharmacopœia, containing, in the form of oil, tallow, nuts, bars, bolts, &c., all the medicine which sick locomotives occasionally require.

At a short distance towards the south we entered a beautiful building, lighted during the day by plate-glass in the roof, by

gas at night, and warmed by steam. In its centre there stands a narrow elevated platform, whereon travels a small locomotive, which brings into the building, and deposits on thirteen sets of rails on each side, twenty-six locomotive engines for examination and repair. On the outside, in the open air, we found at work what is called "*a scrap drum*," which by revolving cleans scraps of old rusty iron, just as a public school improves awkward boys by hardly rubbing them one against another. The scrap iron, after having been by this discipline divested of its rust, is piled on a small wooden board for further schooling, and when sufficiently hot the glowing mass is placed under a steam-hammer alongside, whose blows, each equal to about ten tons, very shortly belabour to "equality and fraternity" the broken bolts, bars, nuts, nails, screw-pins, bits of plate-iron, &c., which are thus economically welded into a solid mass or commonwealth. In another smelting-shop, 150 feet in length, we saw at work fourteen forges, six turning-lathes, one drilling-machine, and one iron-shaving machine. Lastly, there are gas-works for supplying the whole of the Company's establishment with about seventy or eighty thousand cubic feet of gas per day.

The above is but a faint outline of the Company's hospital at Wolverton for the repair and maintenance merely of their locomotive engines running between London and Birmingham.

The magnitude of the establishment will best speak for itself; but as our readers, like ourselves, are no doubt tired almost to death of the clanking of anvils—of the whizzing of machinery—of the disagreeable noises created by the cutting, shaving, turning, and planing of iron—of the suffocating fumes in the brass-foundry, in the smelting-houses, in the gas-works—and lastly of the stunning blows of the great steam-hammer—we beg leave to offer them a cup of black tea at the Company's public refreshment-room, in order that, while they are blowing, sipping, and enjoying the beverage, we may briefly explain to them the nature of this beautiful little oasis in the desert.

Wolverton Refreshment-Room.

In dealing with the British nation, it is an axiom among those who have most deeply studied our noble character, that to keep John Bull in beaming good-humour it is absolutely necessary to keep him always *quite full.* The operation is very delicately called "*refreshing him;*" and the London and North-Western Railway Company having, as in duty bound, made due arrangements for affording him, once in about every two hours, this support, their arrangements not only constitute a curious feature in the history of railway management, but the *dramatis personæ* we are about to introduce form, we think, rather a strange contrast to the bare arms, muscular frames, heated brows, and begrimed faces of the sturdy workmen we have just left.

The refreshment establishment at Wolverton is composed of—

1. A matron or generallissima.
2. Seven very young ladies to wait upon the passengers.
3. Four men and three boys do. do.
4. One man-cook, his kitchen-maid, and his two scullery-maids.
5. Two housemaids.
6. One still-room-maid, employed solely in the liquid duty of making tea and coffee.
7. Two laundry-maids.
8. One baker and one baker's-boy.
9. One garden-boy.

And lastly, what is most significantly described in the books of the establishment—

10. "An odd-man."

"Homo sum, humani nihil à me alienum puto."

There are also eighty-five pigs and piglings, of whom hereafter.

The manner in which the above list of persons, in the routine of their duty, diurnally revolve in "the scrap-drum" of their worthy matron, is as follows:—Very early in the morning—in cold winter long before sunrise—"the odd-man" wakens the two

house-maids, to one of whom is intrusted the confidential duty of awakening the seven young ladies exactly at seven o'clock, in order that their "première toilette" may be concluded in time for them to receive the passengers of the first train, which reaches Wolverton at 7h. 30m. A.M. From that time until the departure of the passengers by the York Mail train, which arrives opposite to the refreshment-room at about eleven o'clock at night, these young persons remain on duty, continually vibrating, at the ringing of a bell, across the rails—(they have a covered passage high above them, but they never use it)—from the North refreshment-room for down passengers to the South refreshment-room constructed for hungry up-ones. By about midnight, after having philosophically divested themselves of the various little bustles of the day, they all are enabled once again to lay their heads on their pillows, with the exception of one, who in her turn, assisted by one man and one boy of the establishment, remains on duty receiving the money, &c. till four in the morning for the up-mail. The young person, however, who in her weekly turn performs this extra task, instead of rising with the others at seven, is allowed to sleep on till noon, when she is expected to take her place behind the long table with the rest.

The scene in the refreshment-room at Wolverton, on the arrival of every train, has so often been witnessed by our readers, that it need hardly be described. As these youthful handmaidens stand in a row behind bright silver urns, silver coffee-pots, silver tea-pots, cups, saucers, cakes, sugar, milk, with other delicacies over which they preside, the confused crowd of passengers simultaneously liberated from the train hurry towards them with a velocity exactly proportionate to their appetites. The hungriest face first enters the door, "magnâ comitante catervâ," followed by a crowd very much resembling in eagerness and joyous independence the rush at the prorogation of Parliament of a certain body following their leader from one house to the bar of what they mysteriously call 'another place.' Considering that the row of young persons have among them all only seven *right hands, with* but very little fingers at the end of each, it is *really astonishing* how, with such slender assistance, they can in

the short space of a few minutes manage to extend and withdraw them so often—sometimes to give a cup of tea—sometimes to receive half-a-crown, of which they have to return two shillings —then to give an old gentleman a plate of warm soup—then to drop another lump of sugar into his nephew's coffee-cup—then to receive a penny for a bun, and then again threepence for four "lady's fingers." It is their rule as well as their desire never, if they can possibly prevent it, to speak to any one; and although sometimes, when thunder has turned the milk, or the kitchen-maid over-peppered the soup, it may occasionally be necessary to soothe the fastidious complaints of some beardless ensign by an infinitesimal appeal to the generous feelings of his nature—we mean, by the hundred-thousandth part of a smile—yet they endeavour on no account ever to exceed that harmless dose. But while they are thus occupied at the centre of the refreshment table, at its two ends, each close to a warm stove, a very plain matter-of-fact business is going on, which consists of the rapid uncorking of, and then emptying into large tumblers, innumerable black bottles of what is not unappropriately called "*Stout*," inasmuch as all the persons who are drinking the dark foaming mixture wear heavy great-coats, with large wrappers round their necks—in fact, are *very* stout. We regret to have to add, that among these thirsty customers are to be seen, quite in the corner, several silently tossing off glasses of brandy, rum, and gin; and although the refreshment-room of the Wolverton Station is not adapted for a lecture, we cannot help submitting to the managers of the Company, that, considering not only the serious accidents that may occur to individual passengers from intoxication, but the violence and insolence which drunken men may inflict upon travellers of both sexes, whose misfortune it may be to be shut up with them; considering moreover the ruin which a glass or two of brandy may bring upon a young non-commissioned officer in the army, as also the heavy punishment it may entail upon an old soldier, it would be well for them peremptorily to forbid, at all their refreshment-rooms, the sale by any of their servants, to the public, of ardent spirits.

But the bell is violently calling the passengers to 'Come!

come away!' —and as they have all paid their fares, and as the engine is loudly hissing—attracted by their pockets as well as by their engagements, they soon, like the swallows of summer, congregate together and then fly away.

It appears from the books that the annual consumption at the refreshment-rooms averages—

182,500	Banbury cakes.		5,110	lbs. of moist sugar.	
56,940	Queen cakes.		16,425	quarts of milk.	
29,200	patés.		1,095	,,	cream.
36,500	lbs. of flour.		8,088	bottles of lemonade.	
13,140	,,	butter.	10,416	,,	soda-water.
2,920	,,	coffee.	45,012	,,	stout.
43,800	,,	meat.	25,692	,,	ale.
5,110	,,	currants.	5,208	,,	ginger-beer.
1,277	,,	tea.	547	,,	port.
5,840	,,	loaf-sugar.	2,095	,,	sherry.

And we regret to add,

666	bottles	of gin.
464	,,	rum.
2,392	,,	brandy.

To the eatables are to be added, or driven, the 85 pigs, who after having been from their birth most kindly treated and most luxuriously fed, are impartially promoted, by seniority, one after another, into an infinite number of pork pies.

Having, in the refreshment sketch which we have just concluded, partially detailed, at some length, the duties of the seven young persons at Wolverton, we feel it due to them, as well as to those of our readers who, we perceive, have not yet quite finished their tea, by a very few words to complete their history. It is never considered quite fair to pry into the private conduct of any one who performs his duty to the public with zeal and assiduity. The warrior and the statesman are not always immaculate; and although at the Opera ladies certainly sing very high, and in the ballet kick very high, it is possible that their voices and feet may sometimes reach rather higher than their characters. Considering, then, the difficult duties which our seven young attendants have to perform—considering the temptations to which they are

constantly exposed, in offering to the public attentions which are ever to simmer and yet never to boil—it might be expected that our inquiries should considerately go no further than the arrival at 11 P.M. of "the up York mail." The excellent matron, however, who has charge of these young people—who always dine and live at her table—with honest pride declares, that the breath of slander has never ventured to sully the reputation of any of those who have been committed to her charge; and as this testimony is corroborated by persons residing in the neighbourhood and very capable of observation, we cannot take leave of the establishment without expressing our approbation of the good sense and attention with which it is conducted; and while we give credit to the young for the character they have maintained, we hope they will be gratefully sensible of the protection they have received.

Postscript.

We quite forgot to mention that, notwithstanding the everlasting hurry at this establishment, four of the young attendants have managed to make excellent marriages, and are now very well off in the world.

Gardens, Libraries, and Schools.

Before leaving Wolverton Station our readers will no doubt be desirous to ascertain what arrangements, if any, are made by the Company for the comfort, education, and religious instruction of the number of artificers and other servants whom we have lately seen hard at work. On the western boundary of the town we visited 130 plots of ground, containing about 324 square yards each, which are let by the Company at a very trifling rent to those who wish for a garden; and, accordingly, whenever one of these plots is given up, it is leased to him whose name stands first on the list of applicants. A reading-room and library lighted by gas are also supplied free of charge by the Company. In the latter there are about 700 volumes, which have mostly been given; and the list of papers, &c. in the reading-room was as follows:—Times, Daily News, Bell's Life, Illustrated News, Punch,

Weekly Dispatch, Liverpool Albion, Glasgow Post, Railway Record, Airs' Birmingham Gazette, Bentley's Miscellany, Chambers' Information, Chambers' Journal, Chambers' Shilling Volume, Practical Mechanic's Journal, Mechanic's Magazine.

Besides the above there is a flying library of about 600 volumes for the clerks, porters, police, as also for their wives and families, residing at the various stations, consisting of books of all kinds, excepting on politics and on religious controversies. They are despatched to the various stations, carriage free, in nineteen boxes given by the Company, each of which can contain from twenty to fifty volumes.

For the education of the children of the Company's servants, a school-house, which we had much pleasure in visiting, has been constructed on an healthy eminence, surrounded by a small court and garden. In the centre there is a room for girls, who, from nine till five, are instructed by a governess in reading, writing, arithmetic, geography, grammar, history, and needlework. Engaged at these occupations we counted fifty-five clean, healthy faces. In the east wing we found about ninety fine, stout, athletic boys, of various ages, employed in the studies above mentioned (excepting the last), and learning, moreover, mathematics and drawing. One boy we saw solving a quadratic equation—another was engaged with Euclid—others with studying land-surveying, levelling, trigonometry, and one had reached conic sections.

At the western extremity of the building, on entering the infant-school, which is under the superintendence of an intelligent looking young person of about nineteen years of age, we were struck by the regular segments in which the little creatures were standing in groups around a tiny monitor occupying the centre of each chord. We soon, however, detected that this regularity of their attitudes was caused by the insertion in the floor of various chords of hoop iron, the outer rims of which they all touched with their toes. A finer set of little children we have seldom beheld; but what particularly attracted our attention was three rows of beautiful babies sitting as solemn as judges on three steps one above another, the lowest being a step higher

than the floor of the room. They were learning the first hard lesson of this world—namely, to sit still; and certainly the occupation seemed to be particularly well adapted to their outlines; indeed their pinafores were so round, and their cheeks so red, that altogether they resembled three rows of white dumplings, with a rosy-faced apple on each. The picture was most interesting; and we studied their cheerful features until we almost fancied that we could analyze and distinguish which were little fire-flies—which small stokers—tiny pokers—infant artificers, &c.

On leaving the three rooms full of children, to whom, whatever may be the religion of their parents, the Perpetual Curate, the Rev. G. Weight, is apparently devoting very praiseworthy attention, we proceeded eastward about 100 yards to the church, the property of the Radcliffe Trustees, the interior of which is appropriately fitted up with plain oak-coloured open seats, all alike. In the churchyard, which is of very considerable area, there are, under the north wall, a row of fraternal mounds side by side, with a solitary shrub or a few flowers at the foot of each, showing that those who had there reached their earthly terminus were kindly recollected by a few still travelling on the rails of life. With the exception, however, of the grave of one poor fellow, whose death under amputation, rendered necessary from severe fractures, has been commemorated on a tombstone by his comrades, there exists no interesting epitaph. Besides this church, a room in the library is used, when required, as a Wesleyan Chapel; at which on Sundays there are regular preachers both morning and night—and on Tuesdays and Fridays about 100 of the Company's servants attend extempore prayers by one of their brother artificers.

CHAPTER X.

LETTERS AND NEWSPAPERS.

AMONG the manifold arrangements which characterise the interior of the British hive there is, we believe, no one which offers to an intelligent observer a more important moral than the respect which is everywhere paid by us to the correspondence of the nation. Prior to the introduction of railways our post-office establishment was the admiration of every foreigner who visited us. But although our light mail-coaches, high-bred horses, glittering harness, skilful coachmen, resolute guards, and macadamised roads were undeniably of the very best description, yet the moral basis on which the whole fabric rested, or rather the power which gave vitality to its movements, evidently was a patriotic desire indigenous in the minds of people of all classes to protect, as their common wealth, the correspondence of the country; and accordingly it mattered not whether on our public thoroughfares were to be seen a butcher's cart, a brewer's dray, a bishop's coach, a nobleman's landau, the squire's chariot or his tenant's waggon;—it mattered not what quantity of vehicles were assembled for purposes good, bad, or indifferent, for church, for race-course, or for theatre;—it mattered not for what party of pleasure or for what political purpose a crowd or a mob might have assembled; for at a single blast through a long tin horn people of all ranks and conditions, however they might be disposed to dispute on all other subjects, were ready from all quarters to join together in exclaiming, "MAKE WAY FOR THE MAIL!"

At the magic whistle of the locomotive engine the whole of the extremely slow, dull, little-bag system we have just referred to suddenly fell to pieces. Nevertheless, the spirit that had animated it flew from the road to the rails, and although our

penny-postal arrangements, notwithstanding their rapid growth, are less conspicuous, there exists throughout the country the same honest anxiety that our letter-bags should be circulated over the surface of the United Kingdom with the utmost possible care and despatch. In order, however, to fulfil this general desire the duties which our Postmaster-General is now required to perform are most extraordinary.

The difficulty of transmitting from London to every part of the United Kingdom, and *vice versâ*, the innumerable quantity of letters which, like mushrooms springing up from a bed of spawn, have arisen from our sudden adoption of a penny-postage, would alone require minute calculations, involving an infinity of details; but when it is considered that besides this circulation from and to the heart of the metropolis—(the average weight of letters and newspapers carried daily by the London and North-Western Railway is seventeen tons)—there exists simultaneously a cross circulation, not only from and to every great city and town, but from every little post-office to every part of the United Kingdom and *vice versâ*, and moreover to every region on the globe, the eccentric zigzag courses of all these letters to their respective destinations may justly be compared to the fiery tracks and sparks created by the sudden ignition of a sackful of fireworks of all descriptions; of rockets, Catherine wheels, Roman candles, squibs, stars, crackers, flower-pots, some flying straight away, while others are revolving, twisting, radiating, bouncing, exploding in every possible direction and in all ways at once.

To explain the mode in which all our postal arrangements are conducted would not only exceed our limits, but be foreign to our subject; we will therefore only attempt to supply our readers with a slight sketch of a very small portion of this business, namely, the transmission of letters from the metropolis by the London and North-Western Railway's night mail.

While the passengers by the Lancashire mail-train are taking their seats and making other preparations for their departure, two or three Post-office vans are seen to enter the main carriage gate of the Euston Station, and then to drive close to their tenders on the railway, which form the last carriages of the train. The

servants of the Post-office, rapidly unloading their vans, remove a portion of the bags they contained into the travelling-office and the remainder into two large tenders, which, as soon as they are filled, are locked up by the guard, who then takes his place in the flying office, in which we propose to leave him to his flight for 132½ miles—only observing, however, that no sooner has he started than another flying post-office, which had been lying in ambush, advances (with its tender), and, after being loaded in a similar manner, in a quarter of an hour they are despatched to Yorkshire and the East of Scotland.

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It had been raining for upwards of twenty-four hours, and it was still pouring when, at about half-past one o'clock of a dark winter's night, we reached the railway platform at Stafford, to await there the arrival from Euston Station of the night-mail, whose loading and departure we have just described. At that lonely hour, excepting a scarlet-coated guard, who, watching over a pile of letter-bags just arrived from Birmingham by a branch-train, was also waiting for the down-mail, there were no other passengers on the platform; and, save the unceasing pattering of the rain, there appeared nothing to attract the attention but the glaring lamps of three or four servants of the Company. One with his lantern in his left hand was writing in a small memorandum-book placed on a desk before him. Two others with lights suspended round their necks were greasing the axles of some carriage whose form could not be distinguished, while the station-man on duty with his lamp in his hand was pacing up and down the boarded platform.

At this moment the signal-man had scarcely announced the approach of an up-train when there rapidly rushed by a very long, low, dark, solid mass protected by some sort of wet black-looking covering which here and there glistened as it rolled past the four lamps that were turned towards it; in short, it was a

common luggage-train. The whole line of waggons, their various contents, as well as the powerful puffing engine that was dragging them through utter darkness, were all inanimate; and it was almost appalling to reflect that, in case of any accident to the drivers, the great train with two red eyes shining in front as well as in rear would proceed alone on its dark iron path—lifeless—senseless—reckless of human life—unconscious of the agonies it might cause or the mischief it might create. It was the work of man—and yet it was ignorant of his power, or even of his name. Devoid of reason or of instinct, it knew nothing—saw nothing—heard nothing—loved nothing—hated nothing—cared for nothing—had no pleasures—no pains—nothing to fear—nothing to hope for; it knew not whence it came,—it rushed forwards it knew not why,—to go it knew not where; it had substance, it had motion, it produced loud sounds, and yet it was as lonely and as destitute of life as the heavens and the earth when in chaos they were without form and void, and when darkness was upon the face of the deep! But these reflections were agreeably interrupted by the arrival of a down-train, swarming alive with passengers, whose busy feet were very shortly to be heard trampling in all directions along or across the platform. At the same time the conductor of the train was delivering over to the Post-office-guard, who had so patiently been awaiting their arrival, a quantity of leather bags of all sizes—white, brown, or black, according to their ages—and which remained in a large heap on the platform until, in about eight minutes, the signal-bell announced first the approach and then the arrival of "the down London mail."

As soon as this train, which we had been awaiting, stopped, the door of the Flying Post-office was opened, and the bags which had been lying on the platform were no sooner packed either into it or into its tender behind, than, the engine-driver's whistle announcing the departure of the train, we without delay presented an order which we had obtained to travel in the post-office from Stafford to Crewe, and we were scarcely seated in a corner on some letter-bags to witness the operations of its inmates, when the train started and away we went!

The flying Post-office.

This office, which every evening flies away from London to Glasgow, and wherein Government clerks are busily employed in receiving, delivering, and sorting letters all the way, is a narrow carpeted room, twenty-one feet in length by about seven in breadth, lighted by four large reflecting lamps inserted in the roof, and by another in a corner for the guard. Along about two-thirds of the length of this chamber there is affixed to the side wall a narrow table, or counter, covered with green cloth, beneath which various letter bags are stowed away, and above which the space up to the roof is divided into six shelves fourteen feet in length, each containing thirty-five pigeon-holes of about the size of the little compartments in a dove-cote. At this table, and immediately fronting these pigeon-holes, there were standing as we flew along, three Post-office clerks intently occupied in convulsively snatching up from the green-cloth counter, and in dexterously inserting into the various pigeon-holes, a mass of letters which lay before them, and which, when exhausted, were instantly replaced from bags which the senior clerk cut open, and which the guard who had presented them then shook out for assortment. On the right of the chief clerk the remaining one-third of the carriage was filled nearly to the roof with letter-bags of all sorts and sizes, and which an able-bodied Post-office guard, dressed in his shirt-sleeves and laced waistcoat, was hauling at and adjusting according to their respective brass-labels. At this laborious occupation the clerks continue standing for about four hours and a half; that is to say, the first set sort letters from London to Tamworth, the second from Tamworth to Preston, the third from Preston to Carlisle, and the fourth letters from Carlisle to Glasgow. The clerks employed in this duty do not permanently reside at any of the above stations, but are usually removed from one to the other every three months.

As we sat reclining and ruminating in the corner, the scene was as interesting as it was extraordinary. In consequence of the rapid rate at which we were travelling, the bags which were

hanging from the thirty brass pegs on the sides of the office had a tremulous motion, which at every jerk of the train was changed for a moment or two into a slight rolling or pendulous movement, like towels, &c., hanging in a cabin at sea. While the guard's face, besides glistening with perspiration, was—from the labour of stooping and hauling at large letter-bags—as red as his scarlet coat which was hanging before the wall on a little peg, until at last his cheeks appeared as if they were shining at the lamp immediately above them almost as ruddily as the lamp shone upon them—the three clerks were actively moving their right hands in all directions, working vertically with the same dexterity with which compositors in a printing-office horizontally restore their type into the various small compartments to which each letter belongs. Sometimes a clerk was seen to throw into various pigeon-holes a batch of mourning letters, all directed in the same handwriting, and evidently announcing some death; then one or two registered letters wrapped in green covers. For some time another clerk was solely employed in stuffing into bags newspapers for various destinations. Occasionally the guard, leaving his bags, was seen to poke his burly head out of a large window behind him into pitch darkness, enlivened by the occasional passage of bright sparks from the funnel-pipe of the engine, to ascertain by the flashing of the lamps as he passed them, the precise moment of the train clearing certain stations, in order that he might record it in his "time-bill." Then again a strong smell of burning sealing-wax announced that he was sealing up, and stamping with the Post-office seal, bags three or four of which he then firmly strapped together for delivery. All of a sudden, the flying chamber received a hard sharp blow, which resounded exactly as if a cannon-shot had struck it. This noise, however, merely announced that a station-post we were at that moment passing, but which was already far behind us, had just been safely delivered of four leather letter-bags, which on putting our head out of the window, we saw quietly lying in the far end of a large strong iron-bound sort of landing-net or cradle, which the guard a few minutes before had by a simple movement lowered on purpose to receive them. But not only

had we received four bags, but at the same moment, and apparently by the same blow, we had, as we flew by, dropped at the same station three bags which a Post-office authority had been waiting there to receive. The blow that the pendent bag of letters, moving at the rate say of forty miles an hour, receives in being suddenly snatched away, must be rather greater than that which the flying one receives on being suddenly at that rate dropped on the road. Both operations, however, are effected by a projecting apparatus from the flying post-office coming suddenly into contact with that protruding from the post.

As fast as the clerks could fill the pigeon-holes before them, the letters were quickly taken therefrom, tied up into a bundle, and then by the guard deposited into the leather bag to which they belonged. On very closely observing the clerks as they worked, we discovered that, instead of sorting their letters into the pigeon-holes according to their superscriptions, they placed them into compartments of their own arrangement, and which were only correctly labelled in their own minds; but as every clerk is held answerable for the accuracy of his assortment, he is very properly allowed to execute it in whatever way may be most convenient to his mind or hand.

Besides lame writing and awkward spelling, it was curious to observe what a quantity of irrelevant nonsense is superscribed upon many letters, as if the writer's object was purposely to conceal from the sorting clerk the only fact he ever cares to ascertain, namely, *the post town*. Their patience and intelligence, however, are really beyond all praise; and although sometimes they stand for eight or ten seconds holding a letter close to their lamp, turning sometimes their head and then it, yet it rarely happens that they fail to decipner it. In opening one bag, a lady's pasteboard work-box appeared all in shivers. It had been packed in the thinnest description of whitey-brown paper. The clerk spent nearly two minutes in searching among the fragments for the direction, which he at last discovered in very pale ink, written apparently through a microscope with the point of a needle. The letters sorted in the flying post-office are, excepting a few "late letters," principally cross-post letters, which,

although packed into one bag, are for various localities. For instance, at Stafford the mail takes up a bag made up for Birmingham, Wolverhampton and intermediate places, the letters for which, being intermixed, are sorted by the way, and left at the several stations.

The bags have also to be stowed away in compartments according to their respective destinations. One lot for Manchester, Liverpool, and Dublin; one for Chester; a bundle of bags for Newcastle-under-Lyne, Market-Drayton, Eccleshall, Stone, Crewe, Rhuabon; a quantity of empty bags to be filled coming back; a lot for Edinburgh, Glasgow, and Carlisle; and one great open bag contained all the letter-bags for Dublin taken upon the road.

The minute arrangements necessary for the transaction of all this important business at midnight, while the train is flying through the dark, it would be quite impossible to describe. The occupation is not only highly confidential, but it requires unceasing attention, exhausting to body and mind. Some time ago, while the three clerks, with their right elbows moving in all directions, were vigorously engaged in sorting their letters, and while the guard, with the light of his lamp shining on the gilt buttons and gold lace which emblazoned the pockets of his waistcoat, was busily sealing a letter-bag, a collision took place, which, besides killing four men, at the same moment chucked the sorting clerks from their pigeon-holes to the letter-bags in the guard's compartment. In due time the chief clerk recovered from the shock; but what had happened—why he was lying on the letter-bags—why nobody was sorting—until he recovered from his stupor he could not imagine.

CHAPTER XI.

CREWE.

WE have now reached the most important station on the London and North-Western Railway; indeed the works here are on a scale which strikingly exemplifies the magnitude of the arrangements necessary for the maintenance of an arterial railway.

The Company's workshops at Crewe consist of a Locomotive and of a Coach department. In the manufactories of the former are constructed as well as repaired the whole of the engines and tenders required for the Northern Division, namely, from Birmingham to Liverpool; Rugby to Stafford; Crewe to Holyhead; Liverpool to Manchester; Liverpool, Manchester, and Warrington to Preston; Preston to Carlisle. The establishment also "works," as it is termed, the Lancaster and Carlisle and Chester and Holyhead Lines. The total number of miles is at present 360, but the distance of course increases with the completion of every new branch line. In this division there are 220 engines and tenders (each averaging in value nearly 2000*l.*), of which at least 100 are at work every day. Besides repairing all these, the establishment has turned out a new engine and tender on every Monday morning since the 1st of January, 1848. The number of workmen employed in the above department is 1600, their wages averaging 3800*l.* a fortnight. The accounts of these expenses, as also a book of "casualties," in which every accident to, as well as every delay of, a train is reported, are examined once a fortnight by a special committee of directors.

Without attempting to detail the various establishments, we will briefly describe a few of their most interesting features.

Close to the entrance of the Locomotive Department stands, as its *primum mobile*, the tall chimney of a steam-pump, which,

besides supplying the engine that propels the machinery of the workshops, gives an abundance of water to the locomotives at the station, as also to the new railway town of Crewe, containing at present about 8000 inhabitants. This pump lifts about eighty or ninety thousand gallons of water per day from a brook below into filtering-beds, whence it is again raised about forty feet into a large cistern, where it is a second time filtered through charcoal for the supply of the town. On entering the great gate of the department, the office of which is up a small staircase on the left hand, the first object of attention is the great engine stable into which the hot dusty locomotives are conducted after their journeys to be cleaned, examined, repaired, or, if sound, to be greased and otherwise prepared for their departure—the last operation being to get up their steam, which is here effected by coal, instead of coke, in about two hours.

After passing through a workshop containing thirty-four planing and slotting machines in busy but almost silent operation, we entered a smith's shop, 260 feet long, containing forty forges all at work. At several of the anvils there were three and sometimes four strikers, and the quantity of sparks that more or less were exploding from each,—the number of sledge-hammers revolving in the air, with the sinewy frames, bare throats and arms of the fine pale men who wielded them, formed altogether a scene well worthy of a few moments' contemplation. As the heavy work of the department is principally executed in this shop, in which iron is first enlisted and then rather roughly drilled into the service of the Company, it might be conceived that the music of the forty anvils at work would altogether be rather noisy in concert. The grave itself, however, could scarcely be more silent than this workshop, in comparison with the one that adjoins it, in which the boilers of the locomotives are constructed. As for asking questions of or receiving explanations from the guide, who with motionless lips conducts the stranger through this chamber, such an effort would be utterly hopeless, for the deafening noise proceeding from the riveting of the bolts and plates of so many boilers is distracting beyond description. We almost fancied that the workmen must be

aware of this effect upon a stranger, and that on seeing us enter they therefore welcomed our visit by a charivari sufficient to awaken the dead. As we hurried through the din, we could not, however, help pausing for a moment before a boiler of copper inside and iron outside, within which there sat crouched up—like a negro between the decks of a slave-ship—an intelligent-looking workman holding with both hands a hammer against a bolt, on the upper end of which, within a few inches of his ears, two lusty comrades on the outside were hammering with surprising strength and quickness. The noise which reverberated within this boiler, in addition to that which was resounding without, formed altogether a dose which it is astonishing the tympanum of the human ear can receive uninjured; at all events we could not help thinking that, if there should happen to exist on earth any man ungallant enough to complain of the occasional admonition of a female tongue, if he will only go by rail to Crewe and sit in that boiler for half an hour, he will most surely never again complain of the chirping of that "cricket on his hearth"—the whispering curtain-lectures of his *dulce domum*.

The adjoining shop contains a brass and also an iron foundry, in which were at work seven brass-moulders and five iron-moulders. In the corner of this room we stood for a few moments looking over the head and shoulders of a fine little boy who was practically exemplifying the properties of the most wonderful of the mineral productions of nature—the loadstone. Among the mass brought into this workshop to be recast are occasionally a quantity of brass shavings and other sweepings, among which there is a small proportion of iron filings, &c. The little boy's occupation consisted in constantly stirring up the mass or mess before him with a magnet, which, as often as it came out bristling with resplendent particles of iron of various sizes, he swept clean, and then continued his work until the investigator came out of the heap as clear of iron as it went in.

Close to this shop is one in which the models and patterns of the castings are constructed. From a spacious open yard covered with stacks of old scrap-iron, much of which was of the size of common buttons, a door opens into a large shop containing

twelve forges solely used for the construction of engine-wheels, which are forced on as well as off their axles by an ingenious machine of extraordinary power. Adjoining the open yard we saw in operation Nasmyth's great steam-hammer, on the summit of which there sat perched up a man who could regulate its blow from say twenty-five tons to a little tap sufficient only to drive a common-sized nail. As soon as the furnace-door on one side of this hammer was opened, a large lump of scrap-iron at a white heat was lifted and then conducted by a crane on to the anvil beneath. At the same moment from an opposite furnace a long iron bar, heated only at one extremity, was by a gentle blow of the hammer no sooner welded to the mass than the head smith, using it as a handle, turned and re-turned the lump on the anvil so as to enable the steam-hammer to weld its contents into proper form. Of course there has been selected for this extremely heavy work the strongest man that could be obtained. He is of about the height and bulk of the celebrated Italian singer Signor Lablache, with apparently the strength of Hercules, or rather of Vulcan himself—and certainly nothing could be a finer display of muscular power than the various attitudes which this heavy man assumed, as, regardless of the sparks which flew at him, or of the white heat of the lump of iron he was forging, he turned it on one side and then on the other, until at a given signal a small smith in attendance placed a sort of heavy chisel on the iron handle, which by a single blow of the steam-hammer was at once severed from it, in order that it might be piled away and another mass lifted from the fiery furnace to the anvil.

Close to this Cyclopean scene there is a shop solely for turning wheels and axles, which, brought here rough from the smiths' forges we have described, never leave this place until they are ready to go under the engine for which they have been made.

After passing through a grinding-shop and a coppersmith's shop, which we must leave without comment, we entered a most important and interesting workshop, 330 feet in length, by 60 feet in breadth, termed the "fitting-shop," because the work brought here in various states is all finally finished and fitted for its object. Besides 11 planing-machines, 36 shaping and slotting ma-

chines, and 30 turning-lathes, all working by steam-power, we observed, running nearly the whole length of the building, five sets of tables, at which were busily employed in filing, rasping, hammering, &c., eight rows of "*vice-men*," only so called because they work at vices. The whole of the artificers in this room are of the best description, and the importance of their duties cannot perhaps be more briefly illustrated than by the simple fact that, besides all the requisite repairs of 200 locomotive engines, they were employed in finishing the innumerable details of 30 new ones in progress. Some were solely engaged in converting bolts into screws; some in fitting nuts; some in constructing brass whistles; in short, in this division of labour almost every "vice man" was employed in finishing some limb, joint, or other component part of a locomotive engine destined to draw trains either of goods or passengers.

After visiting a large store-room, in which all things appertaining to engines, sorted and piled in innumerable compartments, are guarded by a storekeeper, who registers in a book each item that he receives and delivers, we will now introduce our readers to the climax of the establishment, commonly called "*the Erecting-shop.*" Hitherto we have been occupied in following in tedious detail from the foundry to the forge, and from the anvil to the vice, the various items, such as plates, rivets, bolts, nuts, rings, stays, tubes, ferrules, steam-pipes, exhausting-pipes, chimney-pipes, safety-valves, life-guards, axle-boxes, pistons, cylinders, connecting-rods, spiashers, leading and trailing wheels, &c., amounting in number to 5416 pieces, of which a locomotive engine is composed. We have at last, however, reached that portion of the establishment in which all those joints, limbs, and boilers, which have been separately forged, shaped, and finished in different localities, are assembled together for the consummation of the especial object for which, with so much labour and at so great an expense, they have been prepared: indeed, nothing, we believe, can be more true than Mr. Robert Stevenson's well-known maxim—"*A locomotive engine must be put together as carefully as a watch!*"

The Erecting-shop at Crewe is a room 300 feet long by 100

feet broad, containing five sets of rails, upon three of which are erected the new engines and tenders—the other two being usually occupied by those under heavy repair. The number of artificers we found employed was 220. In this magnificent building we saw in progress of erection 20 passenger-engines, also 10 luggage-engines; and as this shop has (as we have before stated) turned out a locomotive engine and tender complete on every Monday morning for very nearly a year, and is continuing to supply them at the same rate, we had before us in review locomotive engines in almost every stage of progress; and when we reflected on the innumerable benefits, and even blessings, which resulted to mankind from their power, it was most pleasing to be enabled at one view to see—as it were in rehearsal behind the scenes—performers who were so shortly to appear upon the stage of life.

At the further end of the line of rails close to the north wall there appeared a long low tortuous mass of black iron-work, without superstructure or wheels, in which the form of an engine-bed in embryo could but very faintly be traced; a little nearer was a similar mass, in which the outline appeared, from some cause or other, to be more distinctly marked; nearer still the same outline appeared upon wheels: to the next there had been added a boiler and fire-box, without dome, steam-escape, or funnel-pipe; nearer still the locomotive engine in its naked state appeared, in point of form, complete:—and workmen were here busily engaged in covering the boiler with a garment about half an inch thick of hair-felt, upon which others were affixing a covering of inch deal-plank, over which was to be tightly bound a tarpaulin, the whole to be secured by iron-hoops. In the next case the dome of the engine was undergoing a similar toilette, excepting that, instead of a wooden upper garment, it was receiving one of copper. Lastly—(it was on a Saturday that we chanced to visit the establishment)—there stood at the head of this list of recruits a splendid bran-new locomotive engine, completely finished, painted bright green—the varnish was scarcely dry—and in every respect perfectly ready to be delivered over on Monday morning to run its gigantic course. On other

rails within the building were tenders in similar states of progress; and, as the eye rapidly glanced down these iron rails, the finished engine and tender immediately before it seemed gradually and almost imperceptibly to dissolve, in proportion to its distance, until nothing was left of each but an indistinct and almost unintelligible dreamy vision of black iron-work. On one of the furthest rails, among a number of engines that were undergoing serious operations, we observed "*The Colonel*," which, by going off the rails at Newton Bridge, caused the death of General Baird.

Coach Department.

As our readers will no doubt feel some little selfish interest in the construction of the railway-carriages in which they travel, we shall conclude our rapid survey of the Company's workshops at Crewe by a short inspection of the coach establishment. This department constructs and maintains for the traffic on 393 miles of rails all the requisite passenger-carriages, luggage-vans, travelling post-offices and tenders, parcel-vans and parcel-carts, milk-trucks (principally to supply Liverpool), and break-waggons.

At the Company's "Waggon Department" at Manchester are constructed and maintained all the requisite goods-waggons, horse-boxes, coke-waggons, carriage-trucks for private carriages, cattle-waggons and timber-trucks.

The total number of carriages of all descriptions maintained at Crewe amounts to 670, of which about 100 at a time are usually in hospital. There are generally from 30 to 40 new carriages in progress: the number of workmen employed was 260. The establishment is divided into one set of workshops for the construction, and another for the repair of carriages.

1. In a large shop, 300 feet in length, warmed by steam, at night lighted by gas, and by day from lofty windows on each side, there is throughout the whole length of the building a wooden pavement containing eight sets of rails, upon which we beheld, like hackney-coaches on their stands, a variety of carriages in various stages of construction and of alteration, each surrounded by several intelligent artificers, who, instead of throwing away

their time in dancing round a tree of liberty, to the tune, or, as it is poetically termed by M. Lamartine, "the dogma" of liberty, fraternity, and *equality*, were sedulously occupied in framing different sorts of carriages to suit the various gradations of human society. For instance, one set, with beautiful colours, were painting the outside of a "first class;" while their comrades within were padding it, and petting it, and stuffing it, as if its object were to fit every bend and hollow in the human frame. Another set were strongly varnishing the wooden oak-painted interior of a "second-class," whose exterior had evidently received considerable attention; while another gang were "finishing off" a covered "third-class," whose inside certainly appeared not only very hard, but what old nurses term "terribly troubled with wind."

In another quarter a set of workmen were economically converting an old first-class into a second-class—the transmutation being effected by taking out the lining, and then converting large, fashionable, oval windows into little vulgar square ones. But though comfort, like cheese, bacon, or any other description of merchandise, was thus doled out to each class of passengers according to the amount of it which they may desire to purchase, the materials of all the carriages appeared to be of good sound quality. The panels of first, second, and third-class carriages, as well as those even of luggage-vans, are invariably made of mahogany; "the bottom-sides" of English oak; the rest of the framing of ash. The break-blocks are made of willow, and usually last about ten weeks' work. Adjoining this congregation of carriages is a smith's shop, containing twenty-eight forges and a tire-oven; above which we found a large store-room filled with lace-trimming, horse-hair, superfine cloth, varnished oil-cloth, nails, rugs, and, among a variety of other requirements, plate-glass for windows. We observed that those for the front glasses of coupés—in order to enable them to resist the occasional pelting of hot cinders from the engine—were half an inch thick! There was also, in an adjoining store, a collection of old cushions, mercilessly indented and worn out by some description of dull heavy pressure.

2. The hospital of the Coach Department at Crewe is an

enormous shed, 600 feet long by 180 broad. It is capable of holding 90 carriages, with ample room for working around them, but only 80 were under repair. Among them we observed several flying post-offices and tenders bearing the Royal arms. Adjoining is a large smith's shop, also a spacious yard containing a heavy stock of timber piled under sheds, with an office for recording the daily amount received and delivered. On entering "*the Grease house*," which, contrary to expectation, we found to be as clean as a dairy, we perceived, standing against the walls, three huge casks of Russia tallow, a quantity of yellow palm-oil, several boxes of soda, and a water-cock. On the opposite side there was a small steam-boiler for heating two open cauldrons and two wooden cooling-vats. This apparatus is constructed for the fabrication of that yellow mixture which our readers have seen bestowed so generously to the axles of the carriages of every train. We had often in vain endeavoured to ascertain its composition, which, from the grease-master, the highest possible authority on the subject, we at last discovered to be as follows :—

200 lbs. of Russia tallow.
70 lbs. of palm-oil.
20 lbs. of soda.
50 gallons of water.

Besides heating the two cauldrons we have mentioned, large iron pipes pass from the steam-boiler to the immediate vicinity of two casks, each containing one ton of sperm-oil, which is thus kept constantly fluid, instead of crystallizing, as it is prone to do, during cold weather.

CHAPTER XII.

A Railway Town.

Having now concluded our rough sketch of the workshops of the locomotive and coach departments at Crewe,—in both of which the Company's artificers and workmen toil both winter and summer from six in the morning till half-past five in the evening, except on Saturdays, when they leave off at four,—our readers will, we hope, feel sufficiently interested in their welfare to inquire, as we anxiously did, a little into their domestic history and comforts. About a hundred yards from the two establishments we have just left there stands a plain neat building, erected by the Company, containing baths, hot, cold, and shower, for the workmen, as well as for their wives and daughters, the hours allotted for each sex being stated on a board, which bluntly enough explains that the women may wash while the men are working, and *vice versâ*. For this wholesome luxury the charge for each person is 1½*d.*; and although we do not just at present recollect the exact price of yellow soap per bar, of sharp white sand per bushel, of stout dowlas-towelling per yard, or the cost of warming a few hundred gallons of water, yet, as we stood gazing into one of these baths, we could not help thinking that if that Hercules who works the steam-hammer can, on Saturday night after his week's toil, be scrubbed perfectly clean and white for three half-pence, he can have no very great reason to complain, for surely, except by machinery, the operation could scarcely be effected much cheaper! To a medical man the Company gives a house and a surgery, in addition to which he receives from every unmarried workman 1*d.* per week; if married, but with no family, 1½*d.* per week; if married, and with a family, 2*d.* per week; for which he undertakes to give

attendance and medicine to whatever men, women, children, or babies of the establishment may require them. A clergyman, with an adequate salary from the Company, superintends three large day-schools for about three hundred boys, girls, and infants. There is also a library and mechanic's institute, supported by a subscription of about 10*s.* a year, at which a number of very respectable artificers, whose education when young was neglected, attend at night to learn, *ab initio*, reading, writing, and arithmetic. There is likewise a vocal and instrumental class, attended by a number of workmen, with their wives and daughters.

The town of Crewe contains 514 houses, one church, three schools, and one town-hall, all belonging to the Company; and as the birth, growth, and progress of a railway town is of novel interest, our readers will, we think, be anxious to learn at what speed our railway stations are now turning into towns, just as many of our ancient post-houses formerly grew into post towns. Although the new houses at Crewe were originally built solely for railway servants, yet it was soon found necessary to construct a considerable number for the many shopkeepers and others who were desirous to join the new settlement, and accordingly, of the present population of 8000, about one-half are strangers. Not only are the streets, which are well lighted by gas, much broader than those of Wolverton, but the houses are, generally speaking, of a superior description, and, although all are new, yet it is curious to observe how insidiously old customs, old fashions, old wants, and even old luxuries, have become domiciled. Many of the shops have large windows, which eagerly attempt to look like plate-glass. In the shoemakers' shops, contrasted with thick railway boots and broad railway shoes, there hang narrow-soled Wellingtons and Bluchers, as usual scarcely half the gauge or breadth of the human foot. The Company's workmen began by having a cheap stout dancing-master of their own; but the aristocracy of Crewe very naturally requiring higher kicks, we found a superior and more elegant artist giving lessons in the town-hall —a splendid room capable of containing 1000 persons.

It would of course be quite irregular for 8000 persons tc live together without the luxury of being enabled occasionally to bite

and tickle each other with the sharp teeth and talons of the law, and accordingly we observed, appropriately inscribed in large letters on the door of a very respectable looking house,

GRIFFIN, ATTORNEY.

Mankind are so prone to draw distinctions where no real differences exist, that among our readers there are probably many who conceive that, although they themselves are fully competent to enjoy Fanny Kemble's readings from Shakspeare, such a mental luxury would be altogether out of character at *New Crewe!* In short, that shops full of smiths and other varieties of workmen (particularly him of the steam-hammer, and most especially the artificer we saw squatted in the boiler), although all exceedingly useful in their ways, could not possibly appreciate the delicate intonations of voice or the poetical beauties to which we have alluded. Now, without the smallest desire to oppose this theory, we will simply state, that while, during the men's dinner-hour, we were strolling through the streets of Crewe, we observed on the walls of a temporary theatre, surrounded by a crowd of gaping mouths and eager unwashed faces, a very large placard, of which the following is a copy :—

BY PARTICULAR DESIRE.

MR. JONES WILL REPEAT

The Scene from Macbeth and Cato's Soliloquy:

LIKEWISE

IMITATIONS OF CHARLES KEMBLE, EDMUND KEAN, AND MR. COOPER.

The town and shops of Crewe are well lighted by gas from the Company's works, which create about 30,000 cubic feet per day —the foot-paths of the streets being of asphalt, composed of the

Company's coal-tar mixed up with gravel and ashes from the workshops. The town is governed by a council of fifteen members, two-thirds of whom are nominated by the workmen and inhabitants, and one-third by the directors. Their regulations are all duly promulgated "by order of the council."

Although our limits do not allow us to enter into many statistical details, we may mention that the number of persons employed on account of the London and North-Western Railway Company, including those occupied in the collection and delivery of goods, is as follows:—

2	Secretaries to the Board of Directors.
1	General Manager.
3	Superintendents.
2	Resident Engineers.
966	Clerks.
3054	Porters.
701	Police-constables.
738	Engine and Firemen.
3347	Artificers.
1452	Labourers.
Total number	10,266

The number of horses employed is . 612
Ditto vans, &c. 253

CHAPTER XIII.

Electric Telegraph.

In strolling down Lothbury, in the City of London, the stranger suddenly sees, opposite to the dull dead wall of the Bank of England and pointing down an alley, the forefinger of a little black hand, under which are written the following words:—

"To the Central Telegraph Station."

and accordingly, at the bottom of the small *cul-de-sac* there it stands, appropriately designated by its "Electric Clock."

On entering the door of this establishment the visitor suddenly finds himself in a very handsome reception-hall, 53 feet long, 32 broad, and 45 feet high, illuminated from above by a skylight, which also gives light to three galleries, one above another, communicating with the various departments of the establishment.

Across this reception-hall, on the left of which are the secretary's and accountant's offices, there is at each side a long counter or table, that on the right being divided by green curtains into six desks, at which are to be seen the round, stout, slight, slim backs of persons of all shapes, and occasionally of both sexes, intently occupied in writing—unseen by each other—the important communications they are severally desirous to despatch. These messages are required to be written on a half-sheet of large-sized letter-paper, nearly one half of which is pre-occupied by a printed form, to be filled up by the name and address of the writer, as also of the person to whom his communication is addressed; the charge of the message, answer, porterage, or cab-hire; the date and hour at which the message is received; and lastly, the date and hour at which the operation of conveying it was commenced and finished by the person who works the electric instrument.

On glancing at these forms our first impression was that the space allotted for the letter or message was insufficient. It is, however, practically found that the Company's charges, which amount, from, say London—

To Birmingham or Stafford	$3\frac{9}{10}$*d.*	per word.
„ Derby, Norwich, Nottingham, or Yarmouth	$4\frac{1}{2}$	„
„ Liverpool, Leeds, Manchester . . .	$5\frac{1}{10}$	„
„ York	$5\frac{2}{3}$	„
„ Edinburgh	$7\frac{1}{2}$	„
„ Glasgow	$8\frac{2}{3}$	„

seriously admonish writers of all descriptions to be as brief as possible: indeed it is a very curious fact in natural philosophy that a lawyer under the Company's galvanic influence is suddenly gifted with a description of *clairvoyance* which enables him to write on any subject in a laconic style, which in his chambers he would consider, and would most conscientiously assure his client, to be utterly impracticable!

As fast as these messages are written, they are, one after another, passed through a glass window to a small compartment, or rather department, on the ground-floor, termed "*the Booking-office*," where, after having been briefly noted and marked with their distinctive numbers, they are by the same hand put into a small box, a bell is then rung, and at the same instant up they fly, through a sort of wooden chimney, to the attic regions of the building, to "*the Instrument department*;" and as we slowly followed them by a staircase, on every landing-place of which we involuntarily paused for a moment or two to reflect on the wonderful process we were about to witness, we own it was with admiration and surprise that, on entering the attic, we suddenly saw before us the simple materials with which such astonishing effects are produced.

In most of our manufactories it may but too truly be said that "the workmanship exceeds the materials." Before a common coffin-nail can be made, the bowels of the earth must be ransacked, ores raised in Cornwall must be smelted in Wales by coals which have been excavated, raised, carted, recarted, &c. The amount of labour which has been expended in the fabrication

of every trifling commodity exhibited in our shops is in a similar manner almost incalculable: indeed if our countrywomen did but know how many hours of unwholesome and unremitting application have been required, nay, how many constitutions have been ruined, in the fabrication of the light beautiful dresses and trinkets that adorn their persons, they would surely feel that their dance, delightful as it may have appeared to them, has been that of death to many of the poorest of their sex. Even the tedious details of the trifling volume we are writing prove that, while the public are luxuriously flying along the rails of only one arterial railway, an army of upwards of ten thousand workmen are labouring in a variety of ways for the management, protection, and maintenance of the way; and as we were not insensible of the usual necessity for these details, we certainly did expect to find that a proportionate amount of labour would be requisite for the simultaneous transmission of messages with extraordinary velocity to distances from one to upwards of four hundred miles. Simplicity, however, is the characteristic of science, and certainly the attics or garrets of the London Central Telegraph Station strikingly illustrate the truth of the axiom: indeed the whole of the Company's stock in trade which we found therein consisted of four or five intelligent-looking boys, from fourteen to fifteen years of age, and eight little "*instruments*," each about half the size of those which German women and Italian men carry on their backs through our streets; and as our advertising horse-dealers, in offering, or, as it is technically termed, in *chaunting* their cob to the notice of "a heavy timid gentleman," invariably assure him "that a child can ride it," so it may truly be said of the electric telegraph, which transmits its intelligence at the incomprehensible rate of 280,000 miles *per second*, that *a boy can guide it!*

Although the ordinary rate at which electric communication is now effected has above been easily expressed by a few figures, it is evident that it is a velocity which the human mind has not power to comprehend.

When Shakspeare, in the exercise of his unbounded imagination, made Puck, in obedience to Oberon's order to him—

" be here again
Ere the leviathan can swim a league,"

reply—

" I'll put a girdle round the earth
In forty minutes"—

how little did our immortal bard think that this light, fanciful offer of " a fairy " to " the king of the fairies," would, in the 19th century, not only be substantially realised, but surpassed as follows.

The electric telegraph would convey intelligence more than twenty-eight thousand times round the earth while Puck, at his vaunted speed, was crawling round it only *once!*

On every instrument there is a dial, on which is inscribed the names of the six or eight stations with which it usually communicates. When much business is to be transacted, a boy is necessary for each of these instruments; generally, however, one lad can without practical difficulty manage about three; but as the whole of them are ready for work by night as well as by day, they are incessantly attended in watches of eight hours each by these satellite boys by day, and by men at night.

As fast as the various messages for delivery, flying one after another from the ground floor up the chimney, reach the level of the instruments, they are brought by the superintendent to the particular one by which they are to be communicated, and its boy, with the quickness characteristic of his age, then instantly sets to work.

His first process is, by means of the electric current, to sound a little bell, which simultaneously alarms all the stations on his line; and although the attention of the sentinel at each is thus attracted, yet it almost instantly evaporates from all excepting from that to the name of which he causes the index needle to point, by which signal the clerk at that station instantly knows that the forthcoming message is addressed solely to *him*, and accordingly by a corresponding signal he announces to the London boy that he is ready to receive it. By means of a brass handle affixed to the dial, which the boy grasps in each hand, he now begins rapidly to spell off his information by certain

twists of his wrists, each of which imparts to the needles on his dials, as well as to those on the dials of his distant correspondent, a convulsive movement designating the particular letter of the telegraphic alphabet required.

By this arrangement he is enabled to transmit an ordinary sized word in three seconds, or about twenty per minute. In case of any accident to the wire of one of his needles, he can, by a different alphabet, transmit his message by a series of movements of the single needle at the reduced rate of about eight or nine words per minute.

While a boy at one instrument is thus occupied in transmitting to—say Liverpool—a message written by its London author in ink which is scarcely dry, another boy at the adjoining instrument is, by the reverse of the process, attentively reading the quivering movements of his dial, which by a sort of St. Vitus's dance are rapidly spelling to him a message, *viâ* the wires of the South-Western Railway, say from Gosport, which word by word he repeats aloud to an assistant, who, seated by his side, writes it down (he receives it about as fast as his attendant can conveniently write it) on a sheet of paper, which as soon as the message is concluded descends to the "Booking Office;" where, inscribed in due form, it is without delay despatched to its destination by messenger, cab, or express, according to order. The following trifling anecdotes will not only practically exemplify the process we have just described, but will demonstrate the rapidity with which the Company are enabled to transmit messages.

Some little time ago, a gentleman, walking into the reception-hall of the London office, stated that he had important business to communicate to his friend at Edinburgh, who by appointment was, he knew, at that moment waiting there to reply to it in the Company's Telegraphic Office. On being presented with the half-sheet of paper, headed with its printed form as described he wrote his query, which, after passing through the glass window to "the Booking Office," flew upwards to the Instrument department, from whence with the utmost despatch it was transmitted to Edinburgh, and, the brief reply almost instant

returning to the instrument, it was committed to writing, and then lowered down to the "gentleman in waiting," who thus quietly walked off with his answer, which we were informed at the office he obtained within the space of five minutes, a considerable portion of which had been consumed by himself and his friend in writing the few words which had passed between them, for, during their passage and return, the electric wires had only detained them exactly the three hundred and fiftieth part of one second!

In a dull foggy day an engine on the London and North-Western Railway, tired of idly standing still with its steam up, suddenly ran away, and, without any one to guide it, proceeded at a rapid rate towards the Euston Station, where every one who witnessed its start expected it would create an amount of damage almost incalculable: but the electric telegraph, soon overtaking and passing the fugitive, conveyed intelligence to Camden Station in abundant time for full preparations to be made there for its reception, by turning the points of the rails into a sideway containing only a few ballast waggons.

In like manner a "gentleman" who had taken for himself and his family only second-class tickets, but who with them had been comfortably enjoying a first-class carriage, was greatly astonished on arriving at his destination to see standing at the window of his carriage, almost before the train had stopped, the Company's station clerk, who very loudly said to him, in presence of his fellow-travellers, "*Mr.* ———, *I'll trouble you for excess of fare for yourself and party!*"

Besides the transmission of *private* messages at charges averaging, say one-fortieth of a penny per mile per word, the Electric Telegraph Company have, in central situations in the principal towns of the kingdom, established stations, whence and where information, messages, and despatches of a public character may be forwarded and received to and from all the other stations of the Company.

In each of these stations a room for subscribers has been established, in which is posted as fast as it arrives all intelligence of commercial or public interest: such, for instance, as—

Prices of Funds and Shares.
Money-market.
Wind and Weather from about forty different parts of the kingdom.
Shipping arrivals and departures.
Losses and disasters at sea.
Sporting intelligence.
Corn-market.
Corn averages.
Cattle-market.
Haymarket.
Meat-market.
Coal, tallow, cotton, and iron markets.
General-Produce market.
General news of the day.
Parliamentary news during the Session.

It need hardly be stated that this intelligence is principally imparted to the various stations from London, where it is concentrated by telegraphic announcements from all quarters.

The "Intelligence Department," which is distinct from the "Private Message Department," is solely for supplying news to the country subscription-rooms at Edinburgh, Glasgow, Liverpool, Leeds, Manchester, Hull, Newcastle, &c.

At 7 in the morning the superintendent of the former department obtains all the London morning newspapers, from which he condenses and despatches to the several electric stations the intelligence he considers most useful to each. The local press of course awaits the arrival, and thus by 8 o'clock A.M. a merchant at Manchester receives intelligence which the rails can only bring at ¼ before 2, and which cannot by rail reach Edinburgh till ½ past 9 P.M.

To Glasgow is transmitted every evening detailed intelligence for immediate insertion in the 'North British Daily Mail,' giving everything of importance that has occurred since the first edition of the London papers. Similar intelligence is despatched to papers at Hull and Leeds.

By this rapid transmission of intelligence, the alternations in the prices of the markets at Manchester, &c. &c., being almost simultaneous with those of London, the merchants of the former are saved from being victimized by the latter. It is true that by great exertions prior intelligence may electrically be sent by private message; but as the wary ones cautiously wait for the despatch of the Telegraph Office, it has but little effect.

At one o'clock information is sent to all the electric reading-rooms of the London quotations of funds and shares up to that hour, thus showing the actual prices at which business has been done. The closing prices of the French funds for the day preceding are usually annexed, and the state of the London wind and weather at that hour.

Early in the morning the instrument boys are to be seen greedily devouring (for, with the curiosity, eagerness, and enthusiasm of youth, they appear to take great interest in their duties) the various matters which from all quarters at once are imparted to them.

One has just received intelligence by telegraph from Ely, announcing the result of the Lynn election. Another, a copy of a 'Moniteur' extraordinary, containing the first message of the President of the French Republic to the President of the National Assembly.

Another, that "Stewart's and Hetton's were nineteen and six-"pence. Gosforth eighteen shill. Holywell fifteen and six-"pence. Hastings Hartley fourteen and ninepence. S Q—"market one hun. fifty one, sold one hun and three—S Q.

"Market very good—P Q."

Another, the following characteristic description of the winds and weather of Old England at 9 A.M.:—

Places.	Wind.	Weather.
Southampton	W.S.W.	Cloudy.
Gosport	S.E.	,,
Portsmouth	S.E.	,,
London	E.	Rain.
St. Ives	W.	Very fine.
Cambridge	S.W.	Cloudy.
Newmarket	E.	Cloudy.
Yarmouth	E.	Fine.
Lowestoffe	E.	Stormy.
Norwich	E.	Fine.
Chelmsford	N.E.	Cloudy.
Colchester	S.E.	Fine.
Ipswich		Fine.

The above description of our changeable climate, it occurred

to us, would not very incorrectly represent the present political state of Europe.

During the day telegraphic information flashes upon these boys *from the* STOCK EXCHANGE, informing them of "prices and closing prices of the funds and principal railway shares. With remarks."

FROM THE LONDON CATTLE MARKET, stating "the number and quality of beasts, sheep, calves, pigs. *Holland* beasts, sheep, calves. *Danish* beasts. With remarks."

FROM THE MEAT MARKET, stating "the prices of every description of meat, with remarks."

Also similar returns from all the other markets we have enumerated.

As fast as this incongruous mass of intelligence arrives, it is, in the mode already described, transcribed in writing to separate sheets of paper, which are without delay one after another lowered down to the superintendent of "*the Intelligence Department*," by whom they are rapidly digested for distribution either to the whole of the Company's reading-room stations, or for those lines only which any particular species of information may partially interest; such as corn-markets requiring corn intelligence; seaports, shipping news, &c. &c.

As quickly as these various despatches are concocted, the information they respectively contain reascends through "the lift," or wooden chimney, to the instrument department, from whence it is projected, or rather radiates, to its respective destination; and thus in every one of the Company's reading-rooms throughout the kingdom there consecutively appears, in what would until very lately have been considered magic writing upon the walls, the varied information which had only reached London from all points of the compass *a few minutes ago!* But not only does this wonderful power, which it has pleased the Almighty to develop to mankind, facilitate in a most extraordinary degree our communication with each other, and thereby materially adds to our wealth, but it affords us a proportionate increase of power to defend that property which, by integrity and industry, our nation has, under Providence, been enabled to acquire.

In case of war, our Commander-in-Chief would not only be made acquainted with information even of the smallest importance as soon as, or even before, it reached our shores, but he would simultaneously be enabled to issue orders to the troops at every station in the kingdom as rapidly as if they were all assembled on the parade before him.

In like manner the Admiralty would receive intelligence and despatch directions, which, in combination with the arrangements at the Horse Guards, War Office, and Home Office, would give to our naval, military, and civil forces a combined strength which it has hitherto been impracticable for them separately to develop.

But to whatever amount the electric telegraph, used in the manner we have described, may facilitate the commerce and strengthen the defences of the empire, there remains to be delineated an application of the discovery which, there can be no doubt, forms the most extraordinary feat which the ingenuity of man has hitherto performed.

In a corner of one of the attics in which the eight electric instruments are placed there stands a small very ordinary-looking piece of cheap machinery composed of a few wheels, giving revolution to a small cylinder, upon which there has been wound a strip of bluish paper half an inch wide and about 60 yards in length.

As this insignificant thread of paper slowly unrolls itself, the stranger observes, with feelings of curiosity rather than of surprise, that as it passes along a small flat surface it receives from a little piece of steel wire about a quarter of an inch long, and about the size of a large needle, a series of minute black marks, composed of "dot and go one,"—two dots,—two dots and a line,—two lines and a dot,—three little lines and a dot,—and so on.

Now many of our readers will, no doubt, gravely exclaim, *But who makes these dots?*

The answer in a few words explains the greatest mechanical wonder upon earth. The little dots and lines marked upon the narrow roll of paper revolving in a garret of the London Central Telegraph Station, are made BY A MAN SITTING IN MANCHESTER,

who, by galvanic electricity, and by the movement of a little brass finger-pedal, is not only communicating to, but is HIMSELF actually PRINTING IN LONDON information which requires nothing but a knowledge of the dotted alphabet he uses to be read by any one to whom it may either publicly or confidentially be addressed ! !

Upon this fact comment is unnecessary. It humbles rather than exalts the mind. Of such an invention it can only be said

" NON NOBIS, DOMINE, SED NOMINI TUO DA GLORIAM."

To supply this instrument with paper there has been invented one of the most beautiful little toys we ever beheld, consisting of two iron fluted rollers four feet long, which, by revolving against each other, draw between them on one side, and emit from the other in a shower of fantastic writhing shreds, a hundred strips of paper half an inch broad at a time.

Before leaving the attics in which the electric printing as well the eight telegraphic instruments are stationed, we may observe that the boys who work the latter form that amount of acquaintance with the workers of the distant instruments with which they have been in the habit of communicating, that, if from any reason their usual correspondents are removed, they instantly discover by the movement of the needles that they have to form an acquaintance with a new comrade, from whom, in leisure moments, they probably soon ascertain the fate of the old one ; indeed, so completely is this description of acquaintance established, that it is not uncommon to hear a telegraph boy in the London attic suddenly exclaim, as he looks with joy at the quivering vibrations of his needles, which are working say from Manchester, " *Oh ! here is Bill * * * come back !*" There are, of course, however, exceptions to these kindly feelings, and accordingly two clerks who had been employed at remote stations on the * * * line were lately separated because they were constantly electrically quarrelling and abusing each other by telegraph.

The working of these instruments requires, as may be supposed, undivided attention, and accordingly there is very properly affixed to the wall of the chamber in which they stand the following notice, which we implicitly obeyed :—

"*Do not interrupt the clerks while engaged at the instruments.*"

As the Vicar of Wakefield's most important movements in life were "from the blue bed to the brown one," so we must now request our readers to migrate with us from the attics of the Electric Telegraph Office to a low, dark, groined, 5th-of-November-looking cellar, thirty-two feet long by five in width, containing three shelves, on which are to be seen, lying in double rows, thirty-four galvanic batteries, or, to speak in more homely terms, small open troughs, five inches broad, and either thirty-two inches or twenty inches in length. The largest, weighing, when charged, 60 lbs., are called "twenty-fours," because they contain that number of pairs of plates of copper and zinc separated by a little sand, the whole being then brought into galvanic action by being sluiced with sulphuric acid and water mixed in the proportions of one of the former to twelve of the latter.

The smallest, called "twelves," contain only that number of pairs of plates.

Of these batteries it requires from four to six of the largest to be applied to one instrument to blow a message from London to Edinburgh. A single "twelve," applied to each instrument, will project intelligence to a range of four or five miles.

These batteries are connected with the eight instruments in the attics by small copper wires, which, to prevent confusion of action from contact one with another, are covered with cotton thread, saturated with a mixture of tar, rosin, and grease.

With this simple precaution, nine wires, insulated from each other, are packed in a half-inch leaden tube, in which they again descend from the instruments to the cellar region. Four or five of these pipes are there packed into an iron pipe three inches in diameter, which conducts them under the foot pavement of the streets to the termini of the arterial rail-roads, alongside of which, and in the open air, a series of lines resembling those on which music is written, composed of galvanised iron, stout enough to bear tension, and suspended by posts, have, as is well known, been constructed. Along the street pavement, at every quarter of a mile, there are cast-iron "*testing-posts*" to enable the Com-

pany's servants to examine all these wires in order to detect and remove any that require to be renewed.

Although the London police have strict orders to allow no one to impede the thoroughfare of the public, and accordingly are everlastingly mumbling the unphilosophical monotonous exhortation of "*Get on, Sir!*" "*Move on, Ma'am!*" yet it is almost impossible for any ruminating being to walk the streets without occasionally pausing to reflect not only on the busy bustling scenes which glide before his eyes, but on those which, at very different rates, are at the same moment flowing beneath his feet.

In our metropolis, there is scarcely a street which does not appear to take pride in exposing as often as possible to public view a series of pipes of all sizes, in which fire of various companies, pure water of various companies, and unmentionable mixtures, abominable to all, pass cheek by jowl with infinitely less trouble than the motley human currents flow above them. But among all the subterranean pipes laid bare before us there is certainly no one which has more curious contents than the three-inch iron pipe of the Electric Telegraph Company; and yet, of all the multitudes who walk the streets, how few of them ever care to reflect what a singular contrast exists between the slow pace at which they themselves are proceeding, and the rate at which beneath their feet forty-five electric wires are transmitting in all directions, and to a variety of distances, intelligence of every possible description!

How singular is it to reflect that, within the narrow space of the three-inch iron pipe which encases them, notice of a murder is flying to London papers, passing news from India going into the country; along another wire an officer is applying for his regimentals, while others are conducting to and fro the "price of stocks," "news of the Pope," a speech from Paris of the "collapsed poet," &c. &c. &c. In case, from the abrasion of the cotton that surrounds the numerous copper wires within the pipe, any of them come into contact with each other, the intelligence which each is conveying is suddenly confounded; in which case other wires must instantly be substituted. Indeed,

even as regards the strong galvanised iron wires which in the open air run parallel with our arterial railways, if in wet weather, in spite of the many ingenious precautions taken, the rain should form a continuous stream between the several wires and the ground, the electric fluid, escaping from the wires, is conducted by the water till it "finds earth," the best of all conductors; and therefore, instead of the intelligence going on, say to Edinburgh, it follows the axiom of electricity by selecting the shortest road, and, thus completing its circuit through the earth, it returns to London. Sometimes, instead of going "to earth," it flies back to the office in London along another wire, to which, by means of a continuous line of water or of entanglement of the two wires, it has managed to escape; in which case, the messages on both wires wrangling with each other, the communication is stopped.

It is commonly asserted and believed that many birds are killed by merely perching upon the iron wires of the electric telegraph; but at any time they can do so with perfect impunity. If, indeed, a bird could put one of his feet on the wire, and with the other manage to touch the earth, he would then, no doubt, be severely galvanised. That the railway company's men often pick up under the wires of the electric telegraph partridges and other birds which have evidently been just killed—indeed, some are found with their heads cut off—is quite true; but these deaths and decapitations have proceeded, not from electricity, but from the birds—probably during twilight or fog—having at full speed flown against the wires, which, of course, cut *their* heads off, just as an iron bar would cut off the head of any man or alderman on horseback who, at a full gallop, was to run foul of it.

In windy weather the electric wires form an Eolian harp, which occasionally emits most unearthly music. "*I say, Jack!*" said an engine-driver to his stoker, who, like himself, was listening for the first time to this querulous sort of noise proceeding from the newly erected wires along his line, "*I say, Jack! ain't they a giving it to 'em at Thrapstone?*"

When the posts and wires of the electric telegraph between

Northampton and Peterborough were being erected, an honest farmer, who for many minutes had very attentively been watching the operation, inquired of the chief superintendent to what use it was to be applied? On being informed that by its means he would in a few minutes receive *at Wellingboro'* a list of the Mark Lane prices *in London*, he evidently incredulously asked how that was to be done; and on its being explained to him that the intelligence would be sent down to him "*letter by letter*," he exclaimed, "But you don't mean to say that, besides letters, it will bring down *parcels* too?"

As the rails and electric wires are now immediately before us, we cannot refrain from observing that the two inventions, like all branches of science, not only materially assist each other, but that the former, to a considerable degree, has created the latter: for instance, it may be truly said that Mr. M'Adam materially assisted the invention of the innumerable little four-wheeled carriages which burst into existence as soon as, in consequence of good roads, it became possible for a single horse to draw a whole family. In like manner, it may, we submit, be reasonably and fairly asserted that the gradients and police of the railway have materially assisted the invention, or rather the application, of galvanic electricity to wires, which, placed along unguarded high roads, would have been practically useless.

On the outside of the Central Telegraph Station, as well as in the interior, there is an electric clock, the latter of which is worked by a small battery contained in a white jar capable of holding about three quarts, and, the pendulum being operated upon by combined electricity with galvanism, the clock requires no winding up, and would, therefore, go perpetually, or rather as long as the battery lasts; and if the Company would, instead of gas-burners, adopt the electric light, their establishment would then, *sui generis*, be complete.

Considerable instruction, with some little amusement, might, no doubt, be derived from a perusal of the variegated information, intelligence, and ordinary as well as extraordinary private

messages which have been despatched and recorded by the electric telegraph; but the Company very properly faithfully refuse—be it important or unimportant—to unveil to any one what they consider to have been confidentially intrusted to their care.

Those, however, who have recourse to the invention often divulge their own secrets; and accordingly here is one which came to us direct from one of the parties concerned.

During a marriage which very lately took place at ———, one of the bridesmaids was so deeply affected by the ceremony, that she took the opportunity of the concentrated interest excited by the bride to elope from the church with an admirer. The instant her parents discovered their sad loss, messengers were sent to all the railway stations to stop the fugitives. The telegraph also went to work, and with such effect that, before night, no less than four affectionate couples legitimately married that morning were interrupted on their several marriage jaunts, and most seriously bothered, inconvenienced, and impeded by policemen and magistrates, who

> "Like envious clouds seem'd bent to dim their glory,
> And check their bright course to the Occident."

On the other hand, when it is considered that young people who form imprudent attachments, instead of being effectually separated, as in old-fashioned times, by distance, can now-a-days, though four or five hundred miles apart, at any moment, by daylight or by moonlight, electrically converse with each other—in short, ask questions and give answers—it must be admitted that, although the galvanic telegraph has certainly triumphantly succeeded in stopping many matches, it has possibly, if the real truth could be known, made quite as many as it has marred.

With respect, however, to communications of this delicate nature, we deem it our duty very gravely to warn our young readers, especially those of the fairer sex, that unless London time were to be adopted—as it is—at all the electric stations, a despatch would arrive at its western destination at an earlier hour than that at which it had left its eastern starting-post;

and thus a young lady might appear to have affirmatively answered in Devonshire an important question—say seven minutes and a half before, according to local clocks, it had actually been proposed to her in London!

In cases where crimes have been committed, the astonishing detective powers of the telegraph have already proved most valuable to the community. As, however, the numberless instances which might be cited are but endless exemplifications of the same principle, we will merely offer to our readers the fragment of one of them.

. . . . . .

He never expected that! . . . . . He had made up his mind to give her the stuff,—he had deliberately bought it,—had paid for it,—had put it into his pocket,—had driven with it to the terminus of the Great Western Railway,—had flown with it along the line to Slough,—had walked with it to the cottage.

He had already deprived the poor creature of her character, and now, on the first day of the year 1845, he had come down to her on purpose to deprive her of her life.

With affected kindness he had offered her refreshment,—had waited while, with his money, she went to buy it,—he had summoned up courage?...no, cowardice and wickedness... enough secretly to pour the stuff from a tiny phial into her glass,—he had seen her, with feelings of gratitude to him, raise the mixture to her faded lips,—he had watched her swallow the first mouthful—then another—then drink,—he had expected every instant, as she reached the drugs, to see his degraded victim drop down dead before his eyes;—he could bear all this, but he did not know that it was the nature of the horrid poison he had purchased to betray the hand that administered it. Oh! he never expected that loud, horrid, piercing, convulsive scream!

As terrified and scared he opened the door to escape, the inhabitants of the neighbouring cottages, alarmed by the frightful noise they had just heard, sympathetically opened theirs. They saw him leave the house with hurried steps,—observed him make for the Slough road, where by another party he was

observed to be "confused—to tremble—and on being addressed, to make no reply." And yet he had only done what he had deliberately intended to perpetrate:—he knew there was no rest for the wicked, but, Oh! he had never expected that shrill, fearful, haunting scream!

On reaching the station he took his place in a departing train, and in a few minutes he apparently had effected his escape!

Everybody who has travelled by the Great Western Railway knows how joyously its well-appointed trains skim along the level country between Slough and London. He no doubt appreciated the speed—valued the wings with which he was flying—more than any of his fellow-passengers. He probably felt that no power on earth could overtake him, and that, if he could but dive into the mass of population in London, he would in perfect security flow with its streams unnoticed.

But whatever may have been his fears—his hopes—his fancies—or his thoughts, there suddenly flashed along the wires of the electric telegraph which were stretched close beside him the following words:—

"A MURDER HAS JUST BEEN COMMITTED AT SALTHILL, AND THE SUSPECTED MURDERER WAS SEEN TO TAKE A FIRST-CLASS TICKET FOR LONDON BY THE TRAIN WHICH LEFT SLOUGH AT 7H. 42M. P.M.

"HE IS IN THE GARB OF A QUAKER, WITH A BROWN GREAT-COAT ON, WHICH REACHES NEARLY DOWN TO HIS FEET. HE IS IN THE LAST COMPARTMENT OF THE SECOND FIRST-CLASS CARRIAGE."

And yet, fast as these words flew like lightning past him, the information they contained, with all its details, as well as every secret thought that had preceded them, had already consecutively flown millions of times faster; indeed, at the very instant that, within the walls of the little cottage at Slough, there had been uttered that dreadful scream, it had simultaneously reached the judgment-seat of Heaven!

On arriving at the Paddington Station, after mingling for some moments with the crowd, he got into an omnibus, and as

it rumbled along, taking up one passenger and putting down another, he probably felt that his identity was every minute becoming confounded and confused by the exchange of fellow-passengers for strangers that was constantly taking place. But all the time he was thinking, the Cad of the omnibus—a policeman in disguise—knew that he held his victim like a rat in a cage. Without, however, apparently taking the slightest notice of him, he took one sixpence, gave change for a shilling, handed out this lady, stuffed in that one, until, arriving at the Bank, the guilty man, stooping as he walked towards the carriage-door, descended the steps;—paid his fare;—crossed over to the Duke of Wellington's statue, where pausing for a few moments, anxiously to gaze around him, he proceeded to the Jerusalem Coffee House,—thence over London Bridge to the Leopard Coffee House in the Borough,—and finally to a lodging-house in Scott's Yard, Cannon Street.

He probably fancied that, by making so many turns and doubles, he had not only effectually puzzled all pursuit, but that his appearance at so many coffee-houses would assist him, if necessary, in proving an *alibi;* but, whatever may have been his motives or his thoughts, he had scarcely entered the lodging when the policeman—who, like a wolf, had followed him every step of the way—opening his door, very calmly said to him—the words no doubt were infinitely more appalling to him even than the scream that had been haunting him—

"HAV'NT YOU JUST COME FROM SLOUGH?"

The monosyllable "NO," confusedly uttered in reply, substantiated his guilt.

The policeman made him his prisoner;—he was thrown into jail;—tried;—found guilty of wilful murder;—and—HANGED.

A few months afterwards, we happened to be travelling by rail from Paddington to Slough, in a carriage filled with people all strangers to one another. Like English travellers, they were all mute. For nearly fifteen miles no one had uttered a single word, until a short-bodied, short-necked, short-nosed, exceedingly respectable-looking man in the corner, fixing his eyes on

the apparently fleeting posts and wires of the electric telegraph, significantly nodded to us as he muttered aloud—

"THEM'S THE CORDS THAT HUNG JOHN TAWELL!"

Having now concluded a rough outline of the practical working of the electric telegraph, it is necessary that we should state—as an important fact on which we offer no comment—that the Company has made arrangements with all the railway companies for working their wires, excepting with the South-Eastern, and, accordingly, that the electric communication between London and Dover is worked by itself, and without connexion with the general system.

The wires of the electrie telegraph from the various lines of railway, carried under the streets, and concentrated at the central station in London, transmit private messages and answers to and from the following places:—

Acklington.	Brandon.	Croft.
Alne.	Brentwood.	Darlington.
Alnwick.	Bridlington.	Derby.
Ambergate.	Brick Lane.	Dereham.
Apperby.	Brockley Whins.	Dorchester.
Ardleigh.	Brockenhurst.	Duffield.
Ashchurch.	Bromsgrove.	Droitwich.
Attleborough.	Brough.	Dunbar.
Audley End.	Broxbourne.	Durham.
Aycliffe.	Burton-on-Trent.	Estrea.
Ayton.	Calverley.	Eckington.
Barking Road.	Cambridge.	Edinburgh
Barnsley.	Castleford.	Edmonton.
Beeston.	Chelmsford.	Elsenham.
Belford.	Cheltenham.	Ely.
Belmont.	Chesterfield.	Fence houses.
Belper.	Chesterford.	Ferry hill.
Bentley.	Chittisham.	Flaxton.
Berwick-on-Tweed.	Church Fenton.	Gateshead.
Beverley.	Clay Cross.	Glasgow.
Birmingham.	Cockburnspath.	Gloucester.
Bishopstoke.	Colchester.	Gosport.
Blackwall.	Colwich.	Granton.
Bradford.	Cowton.	Grantshouse.
Braintree.	Crewe.	Haddington.

Halifax.
Harecastle.
Harling Road.
Harlow.
Helpstone.
Hertford.
Hessle.
Howden.
Hull.
Ilford.
Ingatestone.
Ipswich.
Kegworth.
Keighley.
Kildwick.
Kelvedon.
Kirkstall.
Lakenheath.
Leamside.
Leeds.
Leicester.
Leith.
Lesbury.
Lincoln.
Linlithgow.
Linton.
Liverpool.
London.
Longeaton.
Longniddry.
Longport.
Long Stanton.
Longton.
Loughborough.
Lowestoffe.
Maldon.
Malton.
Manchester.
Manea.
Manningtree.
March.
Masbro'.
Melton.
Mildenhall.
Mile End.
Milford.
Morpeth.
Newark.
Newcastle.
Newmarket.
Newport.
Normanton.
Northallerton.
Norton Bridge.
Norwich.
Nottingham.
Oakenshaw.
Oakington.
Otterington.
Peterborough.
Ponder's End.
Poole.
Portsmouth.
Rillington.
Raskelf.
Reston.
Richmond.
Ringwood.
Rochdale.
Romford.
Rotherham.
Roydon.
Royston.
Rugby.
Sawbridgeworth.
Scarborough.
Selby.
Sessay.
Sheffield.
Shelford.
Shipley.
Skipton.
Slough.
Southampton.
South Shields.
Spetchley.
Stamford.
Stanstead.
Staveley.
St. Ives.
St. Margaret's.
Stoke-on-Trent.
Stone.
Stortford.
Stratford.
Stratford Road.
Sunderland.
Swinton.
Syston.
Tamworth.
Thetford.
Thirsk.
Todmorden.
Tottenham.
Tranent.
Trentham.
Tring.
Tweedmouth.
Ullesthorpe.
Uttoxeter.
Wakefield.
Waltham.
Ware.
Wareham.
Washington.
Waterbeach.
Waterloo Station.
Watford.
Whitacre.
Whittlesea.
Whittlesford.
Wimbourne.
Winchburgh.
Wingfield.
Wisbeach.
Witham.
Wolverton.
Woolwich.
Worcester.
Wymondham.
Yarmouth.
York.

CHAPTER XIV.

Railway Clearing-House.

It is a curious fact that human ignorance, and especially good honest homespun English ignorance, often produces important and highly beneficial results. "*If I had but known what I have had to contend with I would never have undertaken the job,*" is a remark which many a poor emigrant, many a weary traveller, many a journeyman labourer in every department of life, has fervently muttered to himself. The ejaculation is particularly applicable to the original projectors of our railways, who, had they but known the hydra-headed difficulties which, one after another, they would have to encounter, would most surely have kept their money in their pockets, or, in the phraseology of the vulgar, "would never have undertaken the job."

Besides the difficulty of raising money, which during the railway mania certainly amounted to *nil*, there were parliamentary difficulties, engineering difficulties, difficulties of management of various descriptions; and yet, when all these were overcome, when each railway, with its beautiful system of committee-men, secretaries, engineers, surveyors, station-masters, engine-drivers, stokers, pokers, guards, police, superintendents, artificers, labourers, &c., was fully organised and completed, and every line competent along the whole or any portion of its length to convey with safety and due attention every description of traffic, there suddenly appeared a new difficulty, which not only most seriously embarrassed, but which threatened almost to prevent, the combined action of the vertebral railways which at such trouble and cost had just been created. The difficulty alluded to was what is now commonly called "the *through* traffic."

Even before the railway system came into full operation, it was soon found, that to conciliate, or rather to satisfy the just claims of the passenger public, it would be necessary not to harass warm "through" travellers by forcing them to migrate to cold carriages as often as, asleep or awake, dozing or dreaming, they reached each terminus of the various railway companies who, in enmity rather than in partnership, were the proprietors of the consecutive portions of the thoroughfare line.

Again, it was soon found that our merchants and manufacturers as justly insisted rather than requested that their goods and merchandise should go "*through*" to their destinations without being subjected to the delay and serious injury which were unavoidable in repeatedly unpacking and repacking them into fresh waggons. Lastly, it was found that, for cattle and horses, changes of carriages were equally objectionable. The will of the people becoming, therefore, in these instances, the law of the rails, passengers, parcels, goods, horses, and cattle, were, generally speaking, carried "*through*" without change of carriage.

But though the traveller, the receiver of the parcel, of the package, of the horse, dog, bullock, sheep, or pig, after paying for the fare, of course cared not the hundred-thousandth part of a farthing what was done with the money, yet it will be self-evident that he left behind him sources of endless vexation and almost unpreventible disputes; for not only was the paltry fare he had paid for his own conveyance, or that which he might have paid for the conveyance of a lean pig, to be divided among the proprietors of two, three, four, five, six, or seven different companies, but of these companies all excepting one would have not only to remunerate by a mileage allowance the company in whose carriage or waggon, for the benefit of all parties, the traveller, or his parcel, or his goods, or his cow, calf, horse, dog, sheep, or sow, had been carried "through," but an extra charge for demurrage was evidently due to the said company for every day that its carriage or waggon had been detained by the companies to whom it did not belong. The railway companies between London and York first saw the absolute necessity of their endeavouring by some arrangement to settle accounts of this description, which

daily and hourly were growing up between them; but inasmuch as each company, from feelings of jealous independence, kept their books in a different form, dissensions arose, angry correspondence followed, until the settlement of their joint accounts was impeded by the most vexatious delays. The virulence of the disorder, however, was the means of its cure. Mr. Morison, the present very able manager and sole organiser of the new system, conceived the formation of a central office, and the idea was no sooner suggested to Mr. Glyn, the chairman of the London and North Western Railway, than, seeing at a glance its practical bearing, he gave it the whole weight of his well-earned influence, and was mainly instrumental in the establishment of the astonishing system of minute detail which we will now endeavour very briefly to describe.

The Railway Clearing-House, which adjoins the right-hand side of the entrance-gate from Seymour Street to the Euston Station, is under the control of a committee composed of the chairmen of all the railway companies who are parties to the clearing arrangements; the expense of maintaining the establishment being divided rateably among the companies in proportion to the extent of business transacted by it for each.

On opening a street door, which a brass plate beamingly announces to be that of the "Railway Clearing-House," the stranger sees before him a long passage, on both sides of which are hanging, as if for sale, a variety of very decent-looking hats, cloaks, and coats, which he has no sooner passed than he finds himself in a spacious hall or office 78 feet long, 20 wide, and 26 feet high, in which, at one glance, he sees seated or standing before him, at 13 parallel desks, upwards of a hundred well-dressed clerks, each silently occupied either in writing or in apparently carefully investigating that which others have written. The stillness of the scene, to which the public have no admittance, is very remarkable; and before we enter on the subject of the avocation of those before us, we cannot help observing that, to any one who has lately had an opportunity of seeing the number of half-starved men in Paris who, with interminable mustachios and noble bushy beards, are, with depressed heads,

intently engaged in a variety of occupations, down to that of—say—painting a tiny brooch to ornament the bosom of a lady's gown—it is amusing to contrast a body of such fierce-looking warriors "*à demi-solde*" with the plain, clean, close-shorn men of business, who throughout the United Kingdom are, week after week, month after month, and year after year, unassumingly labouring in behalf of that which republicans only talk of instead of attain—a commonwealth.

The business of the Railway Clearing-House is transacted by one manager and 110 clerks. The system comprehends 47 railway companies: in short, it extends to all railways north of the Thames—from Bristol, London, and Harwich, to Aberdeen; and it contains no less than 648 clearing-house stations, by the correspondence of which with the London clearing-office the accounts of the "through" traffic of all the companies is adjudged and settled.

The aforesaid business is divided into four departments:—

First, and most important, the goods and live-stock traffic.

Second, the coaching traffic.

Third, the mileage of carriages and waggons, as also the mileage of tarpaulins for covering waggons.

Fourth, lost luggage.

GOODS.—From each of the 684 Railway Clearing-House Stations which we have enumerated, there is forwarded to the London office a "daily abstract of goods" (printed in black ink), containing the invoice, the amount carted, the sums paid or the sums to pay, the undercharge, the overcharge, and the description of the traffic "*forwarded*" each day from each station to each of the other stations enumerated in the return. Of these goods the gross total is composed of a number of articles, each of which, from the station from which it is forwarded, is charged according to the established rate agreed on by the companies for "through" goods. Some of these weights are only 14 lbs., in which case they, as well as every package below 56 lbs. (termed "a small"), are charged at a higher rate.

2. From each railway clearing station there is forwarded *daily* to the London office a return similar to the above (but for dis-

tinction printed in red ink), of the description, weight, &c. &c., of goods *received* at each station, and thus from two opposite points a detailed return of the amount of goods conveyed between them is declared.

3. As soon as these two returns (black and red) are received at the London office, they are carefully examined, to ascertain if the articles returned in each are correct—that is, if the declaration of the goods *despatched* corresponds with the return of the same goods from the point at which they should have been received. About 30 per cent., however, of the number of items in these returns do *not* correspond, the difference being sometimes a few pounds, sometimes a few pence. Ten clerks are constantly occupied in checking these two sets of returns.

4. As fast as these errors are detected, a "*statement of omissions and inaccuracies*" (in one month 7000 of these statements have been transmitted) are sent from the London office to both parties for explanation, and, when returned by each with "remarks," the errors are corrected according to their replies.

5. From the above accounts a division of the receipts of the goods traffic is made monthly; and as there are 4500 of these settlements (each on an average wanting 2½ copies), about 11,000 copies per month are required. These abstracts are for the following object:—All "*through*" goods arriving in London are by agreement charged with certain terminal expenses for carterage and porterage, which are about double those charged in the country. This monthly settlement, therefore, shows to every company concerned what each is entitled by mileage to receive from one or more companies,—what actually has been received by each,—and consequently the balance due from the one to the other. Hull alone, from its numerous connexions with other stations, receives on an average 200 of these monthly abstracts. Twenty-four clerks are constantly occupied in preparing them.

6. The next operation is, by a consideration of all these balances, to determine what the clearing-house, as the representative of all the creditor companies, is entitled to receive from the debtor companies. The final result of all these operations is exemplified by a monthly return forwarded by the office to each

of the forty-seven companies, showing separately to each, for each of its stations, the weights, the mileage proportions, the terminal expenses, and, lastly, the balances, whether due to it or by it, on the traffic from each of its stations to all other clearing-house stations to which goods had been sent, or from which received. The number of entries in these monthly summaries averages 11,186.

The above closes the account of the goods traffic. Any omission or errors in these accounts are corrected in those of the subsequent month, the balances being, in the first instance, always paid as declared by the London railway clearing-house.

When the balances are finally struck, a letter is addressed from the office to each company, advising it of the amount due to or by it on the traffic of the month; and, unless these balances are paid by each company within twenty-one days, interest at 6 per cent. is charged, and credited to the companies to whom the clearing-house is nominally indebted.

For the convenience of the companies a weekly notice is sent by the London office to each, informing each of the amounts of the receipts of the *through* goods traffic to which it is respectively entitled. This single operation, which enables the companies to publish their weekly receipts, employs nine clerks.

PASSENGERS.—All tickets collected at all the clearing-house stations from *through* passengers are transmitted daily to the London clearing-house, from whence, after being examined and compared with the returns of the tickets issued, they are sent back to the respective companies. From Euston, as well as from all other stations, passenger tickets for every station are each numbered separately from 1 to 10,000, and are issued consecutively, not only for each station, but for each *class* of passengers. In examining these collected tickets, which on an average amount to 9000 per day,—in comparing them with the consecutive numbers as entered in the daily Returns received from the various stations,—and in checking the consecutive numbers themselves, five clerks are employed. The railway clearing-office thus receives—

1. Return from Euston booking-office, as also from all clearing-house passenger stations, stating the number of passengers of each

class booked for all clearing stations, the portions of fares paid by each passenger and due to "foreign" companies.

2. From this account the London clearing-house prepares and forwards daily to each company a return, showing the portion of the fares received at Euston due to each respectively. The above returns are despatched on the evening of the second day.

3. The London clearing-house receives daily from every clearing station a similar return.

4. From these two sets of returns the debtor and creditor account of each company is made up, and kept separate in a book, from which a statement of balances is prepared and forwarded weekly to each company, showing the amount received on its account by the other companies, as also on account of the other companies by it, the balances due to it or by it, and the weekly balance due to or by the clearing-house on behalf of the companies. We may here observe that by the foregoing arrangements, without which the *through* passenger traffic could not possibly be practically carried out, 2,700,000 persons are annually saved the inconvenience of changing their carriage during their journey.

5. The same minute process is pursued with horses, carriages, and dogs, the tickets for which are numbered consecutively, and checked as for passengers. In this duty thirteen clerks are employed.

PARCELS.—The daily returns of the number of parcels despatched and received are checked, and the balance of receipts divided, precisely as the goods, with this addition, that a "way-bill" is sent by each train with the parcels for each station, showing the number of the parcel, the weight, address, and charge; similar bills being also sent from the receiving station to the clearing-house, thus constituting an additional check. For small parcels carried by the passenger-trains from London to Edinburgh the gross charge of 4*s.* is divided among four companies; small charges are often divided among seven companies; and in some cases a charge of 6*d.* is divided among two companies. In this *duty eight clerks* are employed.

At the end of the London Clearing-House three clerks are em

ployed for the live-stock traffic, principally composed of lean stock going to be fattened, of fat cattle, pigs, sheep, and calves going to market. The rates for live stock, like those for goods, are agreed on by all the joint companies, and the returns are sent weekly to the clearing-house. The gross receipts, after deducting a small sum, per waggon, for terminal expenses, are divided, by mileage, among the companies (frequently six in number) concerned.

We have now to endeavour to explain a new branch of the department, termed "*Mileage Branch.*"

In 1848 no less than 443,604 loaded waggons were by various companies (averaging three in number) sent "*through*," besides 267,228 sent back empty. The course of each of these waggons the clearing-house had to trace, in order to ascertain the exact time each was detained on each railway.

The number of miles for which the companies received, through the London clearing-house, payment from each other, amounted to 45,580,884.

The manner in which these extraordinary results are effected is as follows:—

At every junction of railways there are stationed men in the pay of the London Clearing-House, to take the number of all passenger-carriages and goods-waggons, as also of all tarpaulins or sheets covering waggons. These men make to the clearing-office *daily* a detailed statement of the same.

Returns are also sent *daily* from all the clearing-house stations on all the lines of railway, by the servants of the respective companies, of all foreign carriages arriving and departing from each of the said stations. From these returns the London Clearing-House is enabled to trace the course of all waggons and passenger-carriages travelling on what are termed "foreign" lines, and to debit and credit every company with the sums it has respectively incurred for mileage, as also what is due from and to the respective companies for demurrage per day of waggons or of passenger-carriages.

These accounts are transmitted to each company monthly.

Sheets covering waggons are in like manner all checked at

the junctions by the men placed there by the London Clearing-House, as also by returns forwarded to the office from the various stations at which the waggon stops to be loaded or unloaded; and thus the charge of one-tenth of a penny per mile for the use of each of these tarred coverings is divided according to its proper proportion among the respective companies over whose lines it has travelled! For a waggon or carriage from Edinburgh to London, mileage and also demurrage accounts are sent to four companies, and from Arbroath to London to seven companies.

Fourteen clerks are required to keep the mileage and demurrage accounts of carriages and waggons, and eight clerks to keep those of the tarpaulins or sheets.

THE ACCOUNTANT.—Lastly, in the corner of the London office, in a small elevated compartment, about four feet square, sits "the Accountant," who keeps—

1. An account for each separate company (forty-seven in number), showing briefly the sums at their debits and credits, and the balance due to or by each.

2. An interest ledger, showing the amount of interest accruing on balances in arrear, which interest is received by the clearing-house from the Dr. company, and paid to the Cr. company.

3. By the Act of Parliament, every railway company is bound to pay to Government a duty on all sums received by it from passengers, whether on its own account or for other companies. The consequence of this is, that one company is continually obliged to pay duty for another, thus creating a debtor and creditor account for duties, which account the Clearing-House also settles monthly.

LOST LUGGAGE.—The Clearing-House, from its connexion with almost every railway in the kingdom, undertakes the duty of corresponding with all the clearing-house stations from which it receives *daily* returns respecting any unclaimed luggage left on the rails.

At the entrance of the Clearing-Office, in the corner, there is a small post-office of compartments for the letters and returns daily transmitted by the manager to each company.

The office usually receives and despatches 4500 communications per day, employing five lads to open, endorse, and arrange them.

The office is open daily from 9 A.M. till 5 P.M.

With a deep sigh we can truly say that we have now concluded a sketch of the Railway Clearing-House, which, as it gave us one headache to investigate, and another to endeavour to explain, will probably be equally afflicting to our readers.

In justice, however, to the system, we must confess that it is impossible to convey in writing an adequate conception of the infinity of details with which it has to grapple.

The number of items which in the course of a year, by the London office, are examined, traced through many returns, checked, and transferred from one account to another, exceeds rather than falls short of (50,000,000) fifty millions!

It must be obvious to any person conversant with the working of railways, that, without a centralised system of this description, so constituted as to command the confidence of the railway companies, the railway system generally would not only soon become clogged, but constant squabbles and disagreements between the various companies would ensue, to the detriment of their interests, as well as to the discomfort and inconvenience of the public.

The true object, therefore, of the London Railway Clearing-House is to enable the railway companies of the United Kingdom who are parties thereto, to work that enormous traffic, in which they have a common interest, with as much security to themselves, and with as little inconvenience to the public, as if all the associated companies were ONE; and it is evident that in no way could this important object have been effected, except by the establishment of an office which, based on principles of complete centralisation, should be—as the London Clearing-House really is—independent of each company, but under the common control of ALL.

CHAPTER XV

MORAL.

THE few rough sketches which we have now concluded, insignificant and trivial as they may appear in detail, form altogether a mass of circumstantial evidence demonstrating the vast difficulty as well as magnitude of the arrangements necessary for the practical working of great railways; and yet we regret to add, in their general management there exist moral and political difficulties more perplexing than those which Science has overcome, or which order has arranged.—We allude to a variety of interests, falsely supposed to be conflicting, which it is our desire to conciliate, and from which we shall endeavour to derive an honest moral.

When the present system of railway travelling was about to be introduced into Europe, it of course became necessary for Parliament and for His Majesty's Government seriously to consider and eventually to determine whether these great national thoroughfares should be scientifically formed, regulated, and directed by the State, under a Board competently organized for the purpose, or whether the conveyance of the public should be committed to the inexperienced and self-interested management of an infinite number of Joint-stock Companies. Without referring to by-gone arguments in favour of each of these two systems, and, above all, without offering a word against the decision of Parliament on the subject, we have simply to state that the joint-stock system was adopted, and that accordingly capitalists and speculators of all descriptions—men of substance and men of straw—were authorized at their own cost to create and govern the iron thoroughfares of the greatest commercial country in the world. The first result was what might naturally have been

expected, for no sooner was it ascertained that a railway connecting, or, as it may be more properly termed, tapping immense masses of population—such, for instance, as are contained in London, Bristol, Birmingham, Liverpool, Manchester, &c.—was productive of profit, than, just as, when one lucky man finds a rich lode, hundreds of ignorant, foolish people immediately embark, or, as it is too truly termed, *sink* their capital in "*mining*," so it was generally believed that any "*railway*"—whether it connected cities or villages it mattered not a straw—would be equally productive.

The competition thus first irrationally and then insanely created was productive of good and evil. The undertakings were commenced with great vigour. On the other hand, as engineering talent cannot all of a sudden be produced as easily as capital, many important works were constructed under very imperfect superintendence; and as iron, timber, and every article necessary for the construction of a railway simultaneously rose in value, the result was that the expense of these new thoroughfares, which by the exaction of fares proportionate to their outlay must, as we have shown,* eventually be paid for by the public, very greatly exceeded what, under a calm, well-regulated system, would have been their cost. Nevertheless, in spite of all difficulties and expenses, foreseen as well as unforeseen, our great arterial railways were very rapidly constructed.

Their managers, however, had scarcely concluded their "song of triumph," when they found themselves seriously embarrassed by a demand on the part of the public for what has been rather indefinitely termed "cheap travelling;" and as this question involves most serious considerations, we will venture to offer a very few observations respecting it.

There can be no doubt that, inasmuch as it is the duty of Parliament to legislate for the interests of the public, so it is the duty of Her Majesty's Government to exercise their influence in legitimately obtaining for the community *cheap* travelling. But although money is valuable to every man, his life is infinitely more precious; and therefore, without stopping to inquire whe-

* See Chapter I. page 17.

ther by cheap travelling is meant travelling for nothing, for fares unremunerative, or for fares only slightly remunerative to the Company, we submit as a mere point of precedence, that the *first* object the legislature ought to obtain is, that every possible precaution shall be taken to ensure for the public SAFE travelling.

Now, casting aside all petty or local interests, we calmly ask in what manner and by what means would Her Majesty's Government ensure for the public *safe* travelling, supposing our railways were the sole property of the State?

The answer is not only evident, but, we submit, undeniable.

The way, under Providence, to protect the public from avoidable accidents on railways is, utterly regardless of expense, to construct the rails, sleepers, locomotive-engines, and carriages of the very best materials, carefully put together by the best workmen; and then to intrust the maintenance of the line to engineers and other men of science of the highest attainments, assisted by a corps of able-bodied guards, pointsmen, and policemen, all sober, vigilant, active, intelligent, and honest.

Now it is highly satisfactory to reflect that every one of the above costly precautions, as well as all others of a similar nature which a paternal government could reasonably desire to enforce, are as conducive to the real interests of the proprietors of a railway as they are to the safety of those who travel on it; for even supposing that the Directors take no pride in maintaining the character of the national thoroughfare committed to their charge—that, reckless of human life, they care for nothing but their own pockets—a railway accident summarily inflicts upon their purses the same description of punishment instantaneously awarded to a man who carelessly runs his head against a post. For instance, only a few weeks ago a ballast-train on the London and North-Western Railway having stopped for a moment, a goods-train behind it ran into it. No one was hurt excepting the Company—who suffered a loss of 4000*l.* by the collision. Independent, therefore, of the heavy damages readily awarded by juries to any one hurt by a railway accident, the injuries self-inflicted by the Company on their own costly engines, carriages, &c., are most serious in amount, to say nothing of the almost incalculable

embarrassment they may create: indeed, taking into fair consideration the costly results which have occurred to our railway companies by the dislocation of a bolt, the unscrewing of a little nut, or from a variety of other causes equally trifling, it may, we believe, be truly said that the punishments which railway companies have received from accidents have, generally speaking, exceeded rather than fallen short of their offences; and thus every intelligent board of directors is aware that safety in travelling is more emphatically for the interest of railway proprietors than any other consideration whatever: in short, that there is nothing more expensive to a railway Company than an accident.

It being evident, therefore, that it is as much for the interests of railway proprietors as of railway travellers that every possible precaution should be taken by the Company to prevent accidents, we have now to observe that to attain all the necessary securities there is but one thing needful—namely, MONEY. With it Her Majesty's Government might conscientiously undertake the serious responsibility of prescribing all that Science could administer for the safety of the public. Without money, what government or what individual who had any character to lose could for a moment undertake that which his judgment would clearly admonish him to be utterly impracticable? Now, if this reasoning be correct, the managers of our arterial railways were certainly justified in expecting that, if the Government required them to take every possible precaution to ensure *safe* travelling, they would, as a matter of course, assist them in obtaining the same means which they themselves would require had they to effect the same object—namely, MONEY. But instead of endeavouring to obtain for railway companies these means—or rather, instead of enabling them to retain the means which, under their respective Acts of Parliament, they already legally possessed of purchasing security for the public, Parliament, in compliance with a popular outcry for *cheap* travelling, deemed it advisable to require from railways a reduction of the tolls necessary to ensure SAFE travelling.

To any one who will carefully observe the practical working of a railway, it is not only alarming, but appalling, to reflect on

the accidents which sooner or later *must* befall the public if the master-mind which directs the whole concern, but which cannot possibly illuminate the darkness of every one of its details, were suddenly to be deprived of the talisman by which alone he can govern a lineal territory four or five hundred miles in length—namely, an abundant supply of MONEY. Parliament may thunder—Government may threaten—juries may punish—the public may rave; but if the fustian-clad workmen who put together the 5416 pieces of which a locomotive engine is composed are insufficiently paid—if the wages of the pointsmen, enginemen, and police be reduced to that of common labourers—if cheap materials are connected together by scamped workmanship—the black eyes, bloody noses, fractured limbs, mangled corpses of the public, will emphatically proclaim, as clearly as the hopper of a mill, the emptiness of the exchequer. So long as the manager of a railway has ample funds he ought to be prepared, regardless of expense, to repair with the utmost possible despatch the falling-in of a tunnel or any other serious accident to the works—in short, the whole powers of his mind should be directed to the paramount interests of the public, which, in fact, are identical with those of the Company. But if he has no funds—or, what is infinitely more alarming, in case, from want of funds, the impoverished proprietors of the railway shall have angrily elected in his stead the representative of an ignorant, ruinous, and narrow-minded policy—how loudly would the public complain—how severely would our commercial interests suffer, if, on the occurrence to the works of any of the serious accidents to which we have alluded, the new Ruler were to be afraid even to commence any repairs until he should have been duly authorised by his newly-elected economical colleagues to haggle and extract from a number of contractors the cheapest tender!

But we fear it would not be difficult to show that, in reducing the established rates of our great railways before their works were completed, Parliament has unintentionally legislated upon erroneous principles. For instance, we have already explained *that the profit* of a railway depends upon the amount of the *population and* goods which flow upon it from the towns it taps.

If, therefore, the traffic on an arterial line be but moderately remunerative, it must be evident that a branch line must be an unprofitable concern—unless, indeed, the company be authorized to levy upon it *higher* tolls than are sufficient on the trunk line. When, therefore, in the rapid development of our great national railway system it was found necessary for the accommodation of a fraction of the public to apply to Parliament for powers to make these unremunerating branch lines, the companies were certainly in theory entitled to expect the extra assistance we have explained;—instead of which they were practically informed that, unless they would consent to LOWER their tolls altogether, they would not be allowed to develop their system by the construction of any branch line; which is as if a tenant were to say to his landlord—"If you incur the expense of making convenient bye-roads to my farm to enable me with facility to take my crops to market, *you must lower my rent.*"

As it is undeniable that exorbitant rates, besides being inconvenient to the public, are highly injurious to the real interests of railway proprietors—indeed we have shown how enormously the traffic of the country has been increased by low charges—we would be fully disposed, not only most strongly to recommend, but, as far as it may be legal, to enforce, that salutary principle; but the insuperable difficulty of *at present* adjusting the proper tolls to be levied on the public is, that no arterial railway in Great Britain can either declare in figures, or even verbally explain, the real state of its ultimate expenditure and receipts, for the sole reason, namely, that the enterprise is not yet worked out, and that no man breathing can foretell what are to be its limits.

What has become, we ask, of the *old* London and Birmingham Railway (born only in 1836)—of the Grand Junction Railway—of the Manchester and Birmingham—the Liverpool and Manchester Railways—and of a score of others we could name? What has become of the civil, or rather uncivil, war which all these companies waged against each other; as well as against Messrs. Pickford, the most powerful carriers in the world? They have all lost the independence they respectively occupied, and, like the ingredients cast by Macbeth's witches "i' th'

charmed pot," they have "boiled," or, as it is now-a-days termed, amalgamated, into one great stock; and while this long continuous arterial line has been drawing from the public for goods and passenger traffic considerable receipts, it has been, and at various localities still is, draining its own life-blood by the forced construction of a number of sucking branch-lines, which, as far as we can see, are not likely ever to be remunerative.

For some time railway companies deemed it their interest to compete against each other, but this ruinous system was gradually abandoned and is now reversed. The two lines from London to Peterborough, after competing for several months, now divide their profits. The two lines to Edinburgh will probably ere long do the same. But besides this transmutation of competition into combination, public notice was lately given that three of the large arterial lines, namely, the Great Western, the South-Western, and the London and North-Western, were meditating an amalgamation of their respective stocks into one vast concern. On this important project, which for the present has been abandoned, we will offer a very few observations.

We believe it may be affirmed, without fear of contradiction, that the working details of a railway are invariably well executed in proportion to their magnitude:—that, for instance, in the management of the London and North-Western Railway the arrival and departure of trains are better regulated at their large stations than at their small;—that their great manufactories are better and more economically conducted than their little ones;—that the arrangements of Messrs. Pickford and of Messrs. Chaplin and Horne are better at Camden Town than at the small outlying stations;—in short, we most distinctly observed that wherever there was an enormous amount of important business to be transacted, *there* were invariably to be found assembled superior talents, superior workmen, superior materials; and that, on the other hand, at small and secluded localities, where little work was performed, inferior men, inferior waggons, horses, &c., were employed.

In the old system of travelling it was safer to drive along a *lonely road than* through crowded streets; old horses as well as

old drivers were deemed safer than young ones; in fact, the more the traveller was impeded, the less dangerous was his journey. But on our railways, when once a man has tied himself to the tail of a locomotive engine, it matters but little, especially in a fog, whether he flies at the pace of fifty miles an hour, or whether he crawls, as it is now termed, at the rate only of twenty; for, in either case, if there be anything faulty in the works, machinery, or management, accidents may occur to him which it is fearful to contemplate.

Considering, therefore, that not only the ability necessary for the general management of a railway, but the intelligence and vigilance requisite at every station and on every portion of the line are found practically to increase according to the demand, and *vice versâ*, it is evident that nothing would prove more fatal to the public as well as ruinous to proprietors than to split an efficient remunerating great railway into two or more inefficient and unremunerating small ones. A little railway, like "a little war," is murderous to those engaged in it,—ruinous to those who pay for it; and we are therefore of opinion that it is for the interest of the public not only that traffic should be concentrated as much as possible on large lines, rich enough to purchase management, engineering, servants, and materials of the very best description, but that these great lines by uniting together should voluntarily force themselves to exchange all paltry considerations, mean exactions, and petty projects for those great principles which alone should guide the administration of a *national system* of railways. There can be no doubt that any description of monopoly is abstractedly an evil, but if it be equally true that every inch of railway throughout the country represents an integral portion of a vast legally constituted monopolizing system, the practical question to consider is, not whether monopoly is an evil, but whether, of two evils, it would be more or less convenient for Parliament and the public to deal with *one* monopoly than with *many*;—whether, for instance, it would be more or less easy for Government, in recommending alterations of fares, &c., to correspond solely with the directors of the London and North-Western Railway than to communicate *seriatim* with the

boards of the several companies to whom the present line originally belonged, each of which might possibly, in opposition to each other, be pursuing a different course of policy.

As the new system has created an enormous increase of traffic, so it has also, *pari passu*, developed talent proportionate to the extraordinary demand for it; and, therefore, whatever may be the imaginary dangers from a concentrated administration of our railways, we feel confident that the public have much greater reason to apprehend the inconveniences, to say the least, that must inevitably result to them from those sudden unreasonable changes of management, or rather of *mis*management, which are sure periodically to take place so long as every separate railway monopoly arbitrarily pursues not only its own system, but that which its restless shareholders from time to time may think proper to ordain. At all events, until the best plan of managing our great railways shall have been finally ascertained, and most especially until the unknown liabilities, expenses, and receipts attendant upon the establishment over the surface of our country of a series of iron highways shall have been accurately developed, it must be utterly impossible for any practical man to decide to what extent, if any, the Parliamentary tolls originally levied on the public ought in equity to have been reduced.

The great truth, however, sooner or later must appear; and as the hurricane, however violently it may blow, in due time is invariably succeeded by a breathless calm;—as the ocean waves, although mountain high, shortly subside;—as the darkest night in a few hours turns into bright daylight;—so must the present mystified prospects of our great railways inevitably ere long become clear and transparent as those of any other mercantile firm; and when this moment shall have arrived, we believe a very short time will elapse before Parliament, the amalgamated Railway Boards, and the public, will come to a creditable and amicable adjustment; for while, on the other hand, it can never be the interest of the public to prefer *cheap* to SAFE travelling, so it can never be the serious and fixed purpose of any body of men competent to direct the affairs of our arterial railways to exact from the public an exorbitant dividend which must inevitably create

condign punishment; for so sure as water finds its own level will British capital always be forthcoming to lower by legitimate competition anything like a continued usurious exaction from the public. But a moment's consideration of the following facts will show that, as regards railway tolls, the public have as yet no very great reason to complain.

1st. As regards the public:—

In 1835 the fares paid by the public for travelling from London to Liverpool, at the average rate of say 10 miles an hour, were, exclusive of fees to guards and coachmen—

	£.	s.	d.		£.	s.	d.
Per Mail, inside	4	10	0	Outside . .	2	10	0
Per Coach, ditto	4	5	0	Ditto . . .	2	5	0

In 1849 the fares paid by the public for travelling the same distance, at an average rate of 22½ miles per hour (the express trains travelling at about 30 miles per hour) are—

	£.	s.	d.
Per Express and per Mail trains	2	5	0
First Class	1	17	0
Second Class	1	7	0
Third Class	0	16	9

2ndly. As regards the proprietors of Railways:—

In Herapath's Railway Journal of the 30th of September last it appears that the capital expended on railways now open for traffic, amounting to 148,400,000*l.*, gives a profit of 1·81 per cent. for the half-year, or 3*l.* 12*s.* 4¼*d.* per cent. per annum. Deducting the non-paying dividend lines, the dividend on the remainder amounts to 2·09 per cent. for the half-year, or 4*l.* 3*s.* 7½*d.* per cent. per annum.

After ten years' competition with railways the dividends received by the Canal Companies between London and Manchester were in 1846 as follows:—

	Per Cent.
Grand Junction Canal	6
Oxford	26
Coventry	25
Old Birmingham	16
Trent and Mersey	30
Duke of Bridgewater's (private property)	unknown.

The dividends received by the Grand Junction Canal for the last forty years have averaged 9*l.* 10*s.* 9*d.* per cent. per annum.

Great as have been and still are the advantages to the country of our inland navigation, it cannot be denied that the creation of railways was a more hazardous undertaking than the construction of canals. Without, however, offering any opinion as to the relative profits which it has been the fortune of the proprietors of each of these valuable undertakings to divide, we merely repeat that, considering the unknown difficulties which for some time must continue to obscure the future prospects of our railways, it is neither for their interest nor that of the public that the managers of these great national works should in the mean while be cramped by want of means in the development of the important system which it has pleased the Imperial Parliament to commit to their hands instead of to the paternal management of Her Majesty's Government.

If the present alarming depreciation of railway property continue, it is evident that decisive measures, good, bad, or indifferent, will be deemed necessary by the shareholders to prevent, if possible, further loss; and while, on the one hand, the public ought not to be alarmed at impracticable threats, it is only prudent to consider what will probably be the lamentable results of a civil or rather of an uncivilized warfare between the travelling public and the proprietors of the rails on which they travel.

In case the present reduced fares should prove to be unremunerative, we have endeavoured to show that, unless the shareholders in anger elect incompetent managers, the public have no reason to entertain any extra apprehension from accidents;—for the engine-driver might as well desire to run his locomotive over an embankment as a company of proprietors—almost all of whom are railway travellers—become reckless of their property as well as of their lives. Indeed, if railway rates were to be further reduced to-morrow, the public would, we believe, travel as safely, and perhaps even more so, than at present. The result of inadequate rates is not danger, but inconvenience, amounting to deprivation of many of those advantages which the railway system is calculated to bestow upon the country. For instance, to every

practical engineer it is well known that pace is just as expensive on rails as on the road. At present the public travel fast, and those who want to go long distances are accommodated with trains that seldom stop. If, however, it does not suit them to pay for speed, they cannot reasonably expect to have it. If railway companies, as well as the public, are forced to economise, both we believe would eventually be heavy losers by the transaction. The London and North-Western Company, by taking off their express trains, might at once save upwards of 20,000*l.* a-year, besides severe extra damage to their rails. The railways in general might reduce the number of their trains,—make them stop at every little station,—run very slow,—suppress the delivery of day-tickets,—curtail the expenses of their station accommodation,—and finally abandon a number of tributary lines upon which large sums of money have been expended. It must be for the public to determine whether, for the sake of a small saving in their fares, which after all are moderate as compared with other travelling charges, they desire not only to forego the accommodation and convenience to which they have lately become accustomed, but to arrest the development of the railway system to its utmost extent, and with its development its profits.

But, whether our railways be eventually governed by high-minded or by narrow-minded principles,—by one well-constituted amalgamated board, or by a series of small disjointed local authorities,—we trust our readers of all politics will cordially join with us in a desire not unappropriate to the commencement of a new year, that the wonderful discovery which it has pleased the Almighty to impart to us, instead of becoming among us a subject of angry dispute, may in every region of the globe bring the human family into friendly communion; that it may dispel national prejudices, assuage animosities; in short, that, by creating a feeling of universal gratitude to the Power from which it has proceeded, it may produce on earth peace and good will towards men.

HIGH-WAYS AND DRY-WAYS;

OR, THE

BRITANNIA AND CONWAY TUBULAR BRIDGES

CHAPTER I.

THE PRINCIPLE UPON WHICH THE BRITANNIA AND CONWAY TUBULAR BRIDGES HAVE BEEN CONSTRUCTED.

In continuation of our sketch of the practical working of the London and North-Western Railway, we now offer to our readers a short descriptive outline of the aërial passages through which it is proposed by the Directors of the Chester and Holyhead Railway, that the public shall, without cuneiform sustentation, fly across the Menai Straits.

We shall divide our subject into the following compartments:—

1. The principle upon which the Britannia Bridge is constructed.

2. The mode of its construction.

3. The floating of its tubes.

4. The manner in which they are subsequently raised.

5. Mr. Fairbairn's complaint that Mr. Robert Stephenson has deprived him 'of a considerable portion of the merit of the construction of the Conway and Britannia Bridges.'

PRINCIPLE OF THE PROPOSED PASSAGE.

In the construction of a railway from Chester to Holyhead, the great difficulty which its projectors had to contend with was to discover by what means, if any, long trains of passengers and of

goods could, at undiminished speed, be safely transported across that great tidal chasm which separates Carnarvon from the island of Anglesey. To solve this important problem the Company's engineer was directed most carefully to reconnoitre the spot; and as the picture of a man struggling with adversity has always been deemed worthy of a moment's attention, we will endeavour to sketch a rough outline of the difficulties which one after another must have attracted Mr. Robert Stephenson's attention, as on the Anglesey side of the Menai Straits he stood in mute contemplation of the picturesque but powerful adversaries he was required to encounter.

Immediately in his front, and gradually rising towards the clouds above him, were the lofty snow-capped mountains of Snowdon, along the sides of which, or through which, the future railroad, sometimes in bright sunshine and sometimes in utter darkness, was either to meander or to burrow.

Beneath him were the deep Menai Straits, in length above 12 miles, through which, imprisoned between precipitous shores, the waters of the Irish Sea and of St. George's Channel are not only everlastingly vibrating backwards and forwards, but at the same time, and from the same causes, are progressively rising or falling from 20 to 25 feet with each successive tide, which, varying its period of high water every day, forms altogether an endless succession of aqueous changes.

The point of the Straits which it was desired to cross—although broader than that about a mile distant, preoccupied by Mr. Telford's Suspension-bridge—was of course one of the narrowest that could be selected; in consequence of which the ebbing and flowing torrent rushes through it with such violence that, except where there is back-water, it is often impossible for a small boat to pull against it; besides which the gusts of wind which come over the tops, down the ravines, and round the sides of the neighbouring mountains, are so sudden, and occasionally so violent, that it is as dangerous to sail as it is difficult to row; in short, the wind and the water, sometimes playfully, and sometimes angrily, seem to vie with each other—like some of Shakspeare's fairies—in exhibiting before the stranger the utmost variety of fantastic changes which it is in the power of each to assume.

But in addition to the petty annoyances which air, earth, and

water could either separately or conjointly create, the main difficulty which Mr. Stephenson had to encounter was from a new but irresistible element in Nature, an 'orbis veteribus incognitus,' termed in modern philosophy *The First Lord*, or, generically, *The Admiralty*.

The principal stipulation which the requirements of War, and the interests of Commerce, very reasonably imposed upon Science was, that the proposed passage across the Menai Straits should be constructed a good hundred feet above high-water level, to enable large vessels to sail beneath it; and as a codicil to this will it was moreover required that, in the construction of the said passage, neither scaffolding nor centering should be used—as they, it was explained, would obstruct the navigation of the Straits.

Although the latter stipulation, namely that of constructing a large superstructure without foundation, was generally considered by engineers as amounting almost to a prohibition, Mr. Stephenson, after much writhing of mind, extricated himself from the difficulty by the design of a most magnificent bridge of two cast-iron arches, each of which commencing, or, as it is termed, springing, 50 feet above the water, was to be 450 feet broad and 100 feet high—the necessity for centering being very ingeniously dispensed with by connecting together the half arches on each side of the centre pier, so as to cause them to counterbalance each other like two boys quietly seated on the opposite ends of a plank supported only in the middle. This project, however, which on very competent authority has been termed 'one of the most beautiful structures ever invented,' the Admiralty rejected, because the stipulated height of 100 feet would only be attained under the *crown* of the arch, instead of extending across the *whole* of the watercourse. It was also contended that such vast cast-iron arches would take the wind out of vessels' sails, and, as a further objection, that they would inevitably be much affected by alternations of temperature.

Although this stern and unanticipated demand, that the passage *throughout its whole length* should be of the specified height, appeared to render success almost hopeless, it was evidently useless to oppose it. The man of science had neither the power nor the will to contend against men of war, and accordingly Mr. Stephenson felt that his best, and indeed only, course was—

like poor little Oliver Twist when brought before his parish guardians—'TO BOW TO THE BOARD;' and we beg leave to bow to it too, for, gnarled as were its requirements, and flat as were its refusals, it succeeded, at a cost to the Company to which we will subsequently refer, in effecting two great objects;—first, the maintenance for ever, for the purposes of War and Commerce, of an uninterrupted passage for vessels of all nations sailing through the Menai Straits; and secondly, the forcing an eminent engineer to seek until he found that which was required; in fact, just as a collision between a rough flint and a piece of highly-tempered steel elicits from the latter a spark which could not otherwise have appeared, so did the rugged stipulations of the Admiralty elicit from Science a most brilliant discovery, which possibly, and indeed probably, would never otherwise have come to light.

But to return to the Anglesey shore of the Menai Straits.

When Mr. Stephenson, after many weary hours of rumination in his London study, beheld vividly portrayed before him the physical difficulties with which he had to contend in the breadth and rapidity of the stream; when he estimated not only the ordinary violence of a gale of wind, but the paroxysms or squalls which in the chasm before him, occasionally,—like the Erle King terrifying the 'poor baby,'—convulsed even the tempest in its career; and lastly, when he reflected that, in constructing a passage so high above the water, he was to be allowed neither centerings, scaffoldings, nor arches, it occurred to him, almost as intuitively as a man when his house is on fire at once avails himself of the means left him for escape, that the only way in which he could effect his object was by constructing in some way or other, at the height required, a straight passage, which, on the principle of a common beam, would be firm enough to allow railway trains to pass and repass without oscillation, danger, or even the shadow of risk; and it of course followed that an aërial road of this description should be composed of the strongest and lightest material; that its form should be that best suited for averting the wind; and lastly, that no expense should be spared to protect the public from the awful catastrophe that would result from the rupture of this 'baseless fabric' during the passage over it of a train.

It need hardly be stated that, whatever might be the result of Mr. Stephenson's abstract calculations on these points, his practical decision was one that necessarily involved the most painful responsibility; which indeed, if possible, was increased by the reflection that the Directors of the Chester and Holyhead Railway placed such implicit confidence in his judgment and caution, that they were prepared to adopt almost whatever expedient he might, on mature consideration, recommend.

In war, the mangled corpse of the projector of an enterprise is usually considered a sufficient atonement for his want of success; indeed, the leader of the forlorn-hope, who dies in the breach, is not only honourably recollected by his survivors, but by a glorious resurrection occasionally lives in the History of his country: but when a man of science fails in an important undertaking involving the capital of his employers and the lives of the public, in losing his reputation he loses that which *never can be revived!*

Unawed, however, by these reflections, Mr. Stephenson after mature calculations—in which his practical experience of iron-ship building must have greatly assisted him—confidently announced, first to his employers and afterwards to a Committee of the House of Commons, by whom he was rigidly examined, that he had devised the means of accomplishing that which was required; and further, that he was ready to execute his design.

The great difficulty had been in the conception and gestation of his project; and thus his severest mental labour was over before the work was commenced, and while the stream, as it hurried through the Menai Straits, as yet saw not on its banks a single workman.

The outline or principle of his invention was, that the required transit of passengers and goods across the Conway and Menai Straits should be effected through low, long, hollow, straight tubes—one for up-trains, the other for down ones—composed of wrought-iron 'boiler-plates,' firmly riveted together. He conceived that, in order to turn aside the force of the wind, these tubes ought, like common water-pipes, to be made oval or elliptical, and that they should be constructed at their final elevation on temporary platforms, upheld by chains which—notwithstanding the evident objection, in theory as well as in practice, to an

admixture of moveable and immoveable parts—might of course subsequently be allowed to give to the bridge an auxiliary support, although Mr. Stephenson's experience enabled him to declare to the Committee of the House of Commons very positively that no such extra assistance would be required. He proposed that the extremities of the tubes should rest on stout abutments of masonry, terminating the large embankment by which from either side of the country each was to be approached; the intermediate portions of the aërial passage reposing at the requisite elevation upon three massive and lofty towers. Of these one was to be constructed at high-water mark on each side of the Straits. The third, no less than 221 feet in height, was to be erected as nearly as possible in the middle of the stream, on a tiny rock, which, covered with 10 feet of water at high tide, although at low water it protruded above the surface, had long been considered as a grievance by boatmen and travellers incompetent to foresee the important service it was destined to perform.

The four lengths of each of the twin tubes, when supported as described, were to be as follows:—

	Feet.
From Carnarvon embankment, terminating in its abutment, to the tower at high-water mark	274
From the latter tower to Britannia tower, situated upon Britannia rock in the middle of the stream	472
From Britannia tower to that at high-water mark on the Anglesey shore	472
From the Anglesey tower to the abutment terminating the embankment which approaches it	274
Total length of each tube . . .	1492
Total length of both tubes . . .	2984

Notwithstanding the bare proposal of this magnificent conception was unanswerable evidence of the confidence which the projector himself entertained of its principles, yet, in justice to his profession, to his employers, to the public, as well as to himself, Mr. Stephenson deemed it proper to recommend that, during the construction of the towers and other necessary preparations, a series of searching experiments should be made by the most competent persons that could be selected, in order to ascertain the

precise shape and thickness of the immense wrought-iron aërial galleries that were to be constructed, as also the exact amount of weight they would practically bear. In short, the object of the proposed experiments was to ensure that neither more nor less materials should be used than were absolutely requisite, it being evident that every pound of unnecessary weight that could be abstracted would, *pro tanto*, add to the strength and security of the structure.

Although it was foreseen, and very candidly foretold, that these experiments would be exceedingly expensive, the Directors of the Company readily acceded to the requisition, and accordingly, without loss of time, the proposed investigation was, at Mr. Stephenson's recommendation, solely confided to Mr. William Fairbairn, a ship-builder and boiler-maker, who was justly supposed to possess more practical experience of the power and strength of iron than any other person that could have been selected. Mr. Fairbairn, however, after having conducted several very important investigations, deemed it necessary to apply to Mr. Stephenson for permission 'to call in the aid and assistance of Mr. Hodgkinson,' a powerful mathematician, now professor in the University of London, and whom Mr. Stephenson, in his report to the Directors, dated Feb 9, 1846, declared to be 'distinguished as the first scientific authority on the strength of iron beams.' To these two competent authorities Mr. Stephenson subsequently added one of his own confidential assistants, Mr. Edwin Clark, a practical engineer of the highest mathematical attainments, who regularly recorded and reported to Mr. Stephenson the result of every experiment,—to whom the construction and lifting of the Britannia galleries were eventually solely intrusted,—and by whom an elaborate description of that work has just been published.*

* 'With the sanction and under the immediate supervision of Robert Stephenson, Civil Engineer. A Description of the Britannia and Conway Tubular Bridges; including an Historical Account of the Design and Erection, and Details of the Preliminary Experiments, with the Theories deduced from them. Also, General Inquiries on Beams, and on the Application of Riveted Wrought-Iron Plates to Purposes of Construction; with Practical Rules and Deductions, illustrated by Experiments. By Edwin Clark, Assistant Engineer. With Diagrams and a folio volume of Plates and Drawings, illustrative of the Progress of the Works. London: Published for the Author, by John Weale, 59, High Holborn, 1849.'

The practicability of Mr. Stephenson's hollow-beam project having thus, at his own suggestion, been subjected to a just and rigid investigation, we shall have the pleasure of briefly detailing a few of the most interesting and unexpected results; previous, however, to doing so, we will endeavour to offer to those of our readers who may not be conversant with the subject a short practical explanation of the simple principle upon which a beam, whether of wood or iron, is enabled to support the weight inflicted upon it.

If human beings can but attain what they desire, they seldom alloy the gratification they receive by reflecting—even for a moment—on the sufferings which their fellow-creatures may have undergone in procuring for them the luxury in question. Dives sometimes extols his coals, his wine, his food, his raiment, his house, his carriages, and his horses, and yet how seldom does he either allude to or ruminate on the hardships and misery which, for his enjoyment, have been endured in coal-pits, lead-mines, sugar-plantations, cotton-fields, manufactories, smelting-houses, in horticultural and agricultural labour, by the sons and daughters of Lazarus!—and if this heartless apathy characterises human beings with reference to each other, it may naturally enough be expected that, provided *inanimate* objects answer our purpose, we think not of them at all. For instance, if a beam without bending or cracking bears—as it usually does—the weight which the builder has imposed upon it, who cares how it suffers or where it suffers?

For want, therefore, of a few moments' reflection on this subject, most people, in looking up at a common ceiling-girder, consider that the corresponding upper and lower parts thereof must at all events, *pari passu*, suffer equally; whereas these upper and lower strata suffer from causes as diametrically opposite to each other as the climates of the pole and of the equator of the earth; that is to say, the top of the beam throughout its whole length suffers from severe compression, the bottom from severe extension, and thus, while the particles of the one are violently jammed together, the particles of the other are on the point of separation; in short, the difference between the two is precisely that which exists between the opposite punishments of vertically crushing a man to death under a heavy weight, and of horizontally tearing him to pieces by horses!

Now this theory, confused as it may appear in words, can at once be simply and most beautifully illustrated by a common small straight stick freshly cut from a living shrub.

In its natural form, the bark or rind around the stick is equally smooth or quiescent throughout; whereas, if the little bough firmly held in each hand be bent downwards, so as to form a bow, or, in other words, to represent a beam under heavy pressure, two opposite results will instantly appear; namely, the rind in the centre of the upper half of the stick will, like a smile puckering an old man's face, be crumpled up; while on the opposite side immediately beneath, it will, like the unwrinkled cheeks of Boreas, be severely distended—thus denoting or rather demonstrating what we have stated, namely, that beneath the rind the wood of the upper part of the stick is severely compressed, while that underneath it is as violently stretched;—indeed if the little experiment be continued by bending the bow till it breaks, the splinters of the upper fracture will be seen to interlace or cross each other, while those beneath will be divorced by a chasm.

But it is evident on reflection that these opposite results of compression and extension must, as they approach each other, respectively diminish in degree, until in the middle of the beam, termed by mathematicians 'its neutral axis,' the two antagonist forces, like the anger of the Kilkenny cats, or, rather, like still-water between tide and backstream, become neutralised, and, the laminæ of the beam consequently offering no resistance either to the one power or to the other, they are literally useless.

As therefore it appears that the main strength of a beam consists in its power to resist compression and extension, and that the middle is comparatively useless, it follows that in order to obtain the greatest possible amount of strength, the given quantity of material to be used should be accumulated at the top and bottom where the strain is the greatest—or in plain terms the middle of the beam, whether of wood or iron, should be bored out. All iron girders, all beams in houses, in fact all things in domestic or naval architecture that bear weight, are subject to the same law.

The reader has now before him the simple philosophical principle upon which Mr. Stephenson, when he found that he

was to be allowed neither scaffolding, centering, nor arches, determined to undertake to convey at undiminished speed the Chester and Holyhead Railway's passenger and goods traffic across the Conway and Menai Straits through hollow tubes instead of attempting to do so upon solid beams; and as a striking and perhaps a startling exemplification of the truth of his theory, it may be stated that although his plate-iron galleries, suspended by the tension as well as supported by the compression of their materials, have on mature calculations been constructed to bear nearly nine times the amount of the longest railway train that could possibly pass through them (namely, one of their own length), yet if, instead of being hollow, they had been a *solid* iron beam of the same dimensions, they would not only have been unable to sustain the load required, but would actually have been bent by—or, metaphorically, would have fainted under—their own weight!

EXPERIMENTS.

One of the most interesting and important results of the preliminary investigations so ably conducted by Mr. Fairbairn and his friend and associate Mr. Hodgkinson, was the astonishing difference found to exist between the power of cast and that of wrought iron to resist compression and extension. From the experience which engineers and builders had obtained in imposing weights upon cast-iron girders of all shapes and sizes, it had long been considered almost a mechanical axiom that iron possessed greater power to resist compression than extension; whereas Mr. Fairbairn's experiments, to his surprise as well as to that of all who witnessed them, most clearly demonstrated that, after bearing a certain amount of weight, the resisting properties of cast and of wrought iron are diametrically opposite; in short, the results in figures proved to be nearly as follows:

Cast-iron can resist per square inch—

Compression of from 35 to 49 tons.
Extension of ,, 3 7

Wrought-iron can resist per square inch—

Compression of from 12 to 13 tons.
Extension of ,, 16 18

The unexpected results thus obtained were of incalculable practical value; for, if the preliminary experiments proposed by Mr. Stephenson had not been made, he, Mr. Fairbairn, Mr. Hodgkinson, Mr. Clark, and indeed all the eminent engineers and mathematicians of the present day, would—on the correct principle of everywhere adjusting the thickness of iron to the force it has to resist—have erroneously concurred in recommending that the proposed *wrought*-iron tubes for crossing the Conway and Menai Straits should be constructed stronger at bottom than at top, instead of, as it appears they ought to be, stronger at top than at bottom—in consequence of which error the aërial gallery would have been improperly weakened in one part by an amount of iron which would have unscientifically overloaded it at another, and thus, like Falstaff's 'increasing belly and decreasing legs,' the huge mass, with diminished strength, would have laboured under unnecessary weight.

By continuing with great patience and ability the experiments above referred to, it was finally ascertained that the relative strength of *wrought* iron in the top and bottom of the tubes should be in the proportion of about 5 to 4: and whereas, had they been constructed of *cast* iron, these proportions would have been reversed in the higher proportion of nearly 5 to 1, it may reasonably be asked why, if the latter material bears compression so much better than the former, it was not selected for the *top* of the tube? In theory this adjustment of the two metals to the force which each was peculiarly competent to resist, would have been perfectly correct. It, however, could not practically be effected, from the difficulty of casting as well as of connecting together plates 10 and 12 feet in length of the very slight thicknesses required. Mr. Stephenson, therefore, adhered to his original determination to make the whole of his aërial galleries of wrought-iron; and we may here observe that, to ensure the public from accident, he further resolved that the amount of the force of extension upon them should be limited to only one-third of their power of resistance, that of compression to one-half—the reason of the difference being that, inasmuch as any little flaw in the iron would infinitely more impair its power to resist extension than compression, it was evidently safer to approximate the limits of the latter than of the former.

As the exact strength of a hollow wrought-iron tube such was proposed was unknown to engineers, it was deemed necessa by Mr. Stephenson, that its *form* as well as the disposition of materials should be correctly ascertained. This portion of t investigation Mr. Fairbairn and his colleagues with great ca and ability conducted by subjecting tubes of different shapes a series of experiments, the results of which were briefly follows:—

1. CYLINDRICAL TUBES, on being subjected to nine very vere trials, failed successively by collapsing at the top—or, other words, by evincing inability to resist compression:—t tube, losing its shape, gradually became elongated or lante jawed, while the two extremities were observed to flatten bulge out sideways—besides which the ends, which for preca tions' sake rested on concentric wooden beds, invariably be inwards.

2. ELLIPTICAL TUBES, with thick plates riveted to the t and bottom, had been particularly recommended for experime by Mr. Stephenson. These tubes under heavy pressure d played greater stiffness and strength than round or cylindric ones; nevertheless, after being subjected to a variety of torturi experiments of a most ingenious description, they all evinc comparative weakness in the top to resist compression. Th likewise exhibited considerable distortions of form.

3. A family weakness in the head having been thus detect in all models circular at bottom and top, RECTANGULAR TUBI were in their turn next subjected to trial, and as they at on appeared to indicate greater strength than either of the other tv forms had done, a very elaborate and interesting investigati was pursued by Mr. Fairbairn, who, by the light of his exper ments, soon satisfied himself of the superiority of this form ov the other two; and as every successive test confirmed the fac he continued his search with an energy that has only since be equalled by the American judge who, on arriving at Californi deserted the bench for 'the diggings.'

The following is an abstract of the important result of abo *forty experiments* made by Messrs. Fairbairn, Hodgkinson, ar

Clark, on the comparative strength of circular, elliptical, and rectangular tubes:—

CIRCULAR, 13; ELLIPTICAL, 15; RECTANGULAR, 21.

As soon as the rectangular was by the investigation recommended by Mr. Stephenson clearly ascertained to be the best form of hollow tube that could be selected, the next important problem to be determined by experiment was what amount of strength should be given to it, or, in other words, what should be the thickness of its top and bottom, in which, as we have shown, consisted its main power.

The investigations on this subject soon demonstrated that if, instead of obtaining this thickness by riveting together two or three layers of plates, they were, on the principle of the beam itself, placed in horizontal strata a foot or two asunder—the included hollow space being subdivided by small vertical plates into rectangular passages or flues extending along the whole top as well as bottom of the tube—an immense addition of strength, with very nearly the same weight of material, would be obtained, and this adaptation proving highly advantageous, it was deemed advisable by Mr. Stephenson that further experiments should be made by Mr. Fairbairn and his colleagues to determine finally the precise form and proportions of the great tubes.

For this object an entirely new model tube, one-sixth of the dimensions of the intended Britannia Bridge, was very carefully constructed; and the cellular tops and bottoms thereof, as well as the sides, were subjected to a series of experiments until the exact equilibrium of resistance to compression and extension, as also the variations in the thicknesses of the plates in the several parts of the tube as they approached or receded from different points of support, were most accurately ascertained.

In these as well as in all the previous experiments the trial tubes were loaded till they gave way—the results being accurately recorded and transmitted by Mr. E. Clark to Mr. Stephenson, who in return confidentially assisted Mr. C. with his opinion and advice. From the fibrous nature of wrought-iron, as compared with the crystalline composition of the cast metal, the tendency to rupture in most of these experiments was slow and

progressive. Destruction was never instantaneous, as in cast-iron, but it advanced gradually; the material, for some time before absolute rupture took place, emitting an unmistakeable warning noise; just as a camel while kneeling on the burning sandy desert, and while writhing his head from one side to the other, snarls, grunts, grumbles, and groans louder and louder, as his swarthy turbanheaded owners keep relentlessly adding package after package to his load.

Although it can mathematically be shown that the two sides of a thin hollow tube are of but little use except to keep the tops and bottoms at their duty—the power of resistance of the latter being, however, enormously increased by the distance that separates them—it was nevertheless necessary to ascertain the precise amount of lateral strength requisite to prevent the aërial gallery writhing from storms of wind. The riveting process was likewise subjected to severe trial, as also the best form and application of the slender ribs termed 'angle-irons,' by which not only the plates were to be firmly connected, but the tube itself materially strengthened;—in fact, the angle-irons were to be its bones, the thin plate-iron covering being merely its skin.

Mr. Stephenson had two main objects in instituting the investigations we have detailed. First, to determine by actual experiment what amount of strength *could* be given to his proposed galleries; and, secondly, of that maximum *how much* it would be proper for him to exert. And as his decisions on these subjects will probably be interesting to our readers, most especially to that portion of them whose fortunes or fate may doom them occasionally to fly through his baseless fabric, we will endeavour very briefly to explain the calculations on which they appear to have been based.

As a common railway train weighs upon an average less than a ton per foot,—as the greatest distances between the towers of the Britannia Bridge amount each to 460 feet,—and as it is a well-known mathematical axiom among builders and engineers that any description of weight spread equally along a beam produces the same strain upon it as would be caused by half the said weight imposed on *the centre*,—it follows that the maximum weight which a monster train of 460 feet (an ordinary train

averages about half that length) could at one time inflict on any portion of the unsupported tube would amount to 460 tons over the whole surface, or to 230 tons at the centre.

Now, to ensure security to the public, Mr. Stephenson, after much deliberation, determined that the size and adjustment of the iron to be used should, according to the experiments made and recorded, be such as to enable the aforesaid unsupported portions of the tube (each 460 feet in length) to bear no less than 4000 tons over its whole surface, or 2000 tons in the centre, being nine times greater than the amount of strength necessarily required; and as the results—expected as well as unexpected—of the searching investigation which had been instituted, incontestably proved that this Herculean strength could be imparted to the galleries without the aid of the chains, which, even as an auxiliary, had been declared unnecessary,—and as Mr. E. Clark had very cleverly ascertained that it would be cheaper to construct the tubes on the ground than on the aërial platform as first proposed,—Mr. Stephenson determined, on mature reflection, to take upon himself the responsibility of reporting to the Directors of the Chester and Holyhead Railway that this extra catenary support, which would have cost the Company 150,000*l.*, was wholly unnecessary. Indeed, such was the superabundance of power at his command, that, without adding to the weight of the rectangular galleries, he could materially have strengthened them by using at their top and bottom circular flues instead of square ones, which, merely for the convenience of cleaning, &c., were adopted, although the former were found on experiment to bear about 18 tons to the square inch before they became crushed, whereas the latter could only support from 12 to 14 tons.

But the security which Mr. Stephenson deemed it necessary to ensure for the public may further be illustrated by the following very extraordinary fact:—It has been mathematically demonstrated by Messrs. Hodgkinson and Clark, as well as practically proved by Mr. Fairbairn—indeed it will be evident to any one who will go through the necessary calculations on the subject—that the strain which would be inflicted on the iron-work of the longest of Mr. Stephenson's aërial galleries by a monster train sufficient to cover it from end to end, would amount to six tons per square inch:—which is exactly equal to the constant

stress upon the chains of Telford's magnificent suspension Menai Bridge when, basking in sunshine or veiled in utter darkness, it has nothing to support but its own apparently slender weight!

LATERAL STRENGTH.—The aërial galleries having, as above described, been planned strong enough for the safe conveyance of goods and passengers at railway speed, it became necessary to calculate what *lateral* strength they would require to enable them to withstand the storms, tempests, squalls, and sudden gusts of wind to which from their lofty position they must inevitably be exposed.

The utmost pressure of the hurricane, as estimated by Smeaton —but which is practically considered to be much exaggerated —amounts to about 46 lbs. to the square foot; and this, on one of the large tubes (460 feet long by an average of rather less than 30 feet high) would give a lateral pressure of 277 tons over the whole surface, or of 133 tons on the centre.

To determine the competency of the model tube to resist proportionate pressure to this amount, it was turned over on its side; and, having by repeated experiments been loaded and overloaded until it was crushed, the result fully demonstrated to Mr. Stephenson's satisfaction its power to resist, according to his desire, a lateral pressure more than five times greater than that which it is in the power of the hurricane to inflict.

The experimental information required by Mr. Stephenson having, by the zeal and ability of Mr. Fairbairn, Mr. Hodgkinson, and Mr. Clark, been finally obtained, the next points for consideration came to be, where these gigantic twin-tubular galleries should be constructed, and when constructed, by what power, earthly or unearthly—it will appear that the latter was found necessary—they should be raised to the lofty position they were decreed to occupy.

After much reflection on Mr. E. Clark's valuable suggestions on these subjects, Mr. Stephenson determined—1st. That the four shortest galleries, each 230 feet in length, (to be suspended at the height in some places of 100 feet between the two land towers and the abutments of the approaching embankments,) *should*, as he had originally proposed, be at once permanently

constructed on scaffoldings in the positions in which they were respectively to remain;

2ndly. That the four longest galleries (each 472 feet in length), which were eventually to overhang the straits, should be completely constructed at high-water mark on the Carnarvon shore, upon wooden platforms about 400 feet westward of the towers on which they were eventually to be placed;

3rdly. That to the bases of these towers they should, when finished, be floated on pontoons, from which they were to be deposited on abutments in the masonry purposely made to receive them; and,

4thly. That the tubes should be raised to and finally deposited in their exalted stations by the slow but irresistible power of hydraulic presses of extraordinary force and size.

CHAPTER II.

CONSTRUCTION OF THE TUBES AND TOWERS.

THE locality selected for the formation of the tubes having been cleared, a substantial platform, composed of balks of timber covered with planks, was very quickly laid down.

In the rear of this immense wooden stage, which extended along the shore no less than half a mile, covering about three acres and a half, there were erected three large workshops, containing forges and machinery of various descriptions, for belabouring, punching, and cutting plate-iron. There were likewise constructed five wharves with cranes for landing materials, as also six steam-engines for constant work. The number of men to be employed was—

On iron-work about	700
At stone-work for the towers . . .	800
Total	1500

With mushroom growth temporary shanties or wooden cottages, whitewashed on the outside, suddenly appeared in the green fields and woods immediately adjoining; besides which, accommodation was provided for a school-room, schoolmaster, clergyman, and, in case of accidents, for a medical man, the whole being agreeably mixed up with a proportion of wives, sweethearts, and children, sufficient for cooking, washing, sewing, squalling, &c. Nevertheless, notwithstanding these alluring domestic arrangements, many sturdy independent workmen preferred sleeping in villages four and five miles off, to and from which they walked every morning and evening, in addition to their daily work; the remainder gipsying in the encampment in various ways, of which the following is a sample:—

An Irish labourer, known only by the name of 'Jemmy,' *bought* for himself a small clinker-built room. As 'lodgings,' *however, soon* rose in price, and as he had not time to keep a pig,

he resolved to be satisfied henceforwards with half his tiny den, and accordingly let the remainder to a much stronger fellow-countryman, who, being still less particular, instantly let half of his half to a very broad-shouldered relation, until, like other Irish landlords we could name, poor 'Jemmy' found it not only very difficult to collect, but dangerous even modestly to *ask* for, 'his rint'! and thus in a short time, in consequence of similar 'pressure from without,' almost every chamber was made to contain four beds, in each of which slept two labourers.

As soon as the preliminary wharves, platforms, shanties, and workshops were completed, there instantly commenced a busy scene strangely contrasted with the silence, tranquillity, and peaceful solitude that had previously characterised the spot. While large gangs of masons were excavating the rocky foundations of the land towers, sometimes working in dense groups, and sometimes, in 'double quick time,' radiating from each other, or rather from a small piece of lighted slow-match, sparkling in the jumper-hole of the rock they had been surrounding;—while carts, horses, and labourers in great numbers were as busily employed in aggregating the great embankments by which these towers were to be approached;—while shiploads of iron from Liverpool —of Anglesey marble from Penmon—of red sandstone from Runcorn in Cheshire—at rates dependent upon winds and tides, were from both entrances to the straits approaching or endeavouring to approach the new wharves;—while almost a forest of scaffold balks of the largest and longest description—like Birnam wood coming to Dunsinane—were silently gliding towards the spot;—while waggons, carts, post-chaises, gigs, horses, ponies, and pedestrians, some of the latter carrying carpet-bags and some bundles, &c., were to be seen on both sides of the straits eagerly converging across the country to the new settlement or diverging from it:—the unremitting clank of hammers,—the moaning hum of busy machinery,—the sudden explosion of gunpowder,—the white vapour from the steam-engines,—and the dark smoke slowly meandering upwards from their chimneys, gave altogether interest, animation, and colouring to the picture.

As our readers will, however, probably be anxious to know how the great tubes which have been delineated are practically constructed, we will shortly describe the operation, which we are

happy to say, is contained in a vocabulary of only three words, these aërial galleries being solely composed of—Plates,—Rivets,—and Angle-Irons.

PLATES.

The wrought-iron plates which form the top, bottom, and sides of the Britannia 'land tubes,' 230 feet in length, are, of course, slighter than those required for the four, each 460 feet, which overhang the stream.

For these long tubes—which are of the same height and breadth as the shorter ones—the dimensions of the plates are as follows:—

For the bottom	12 feet in length, 2 feet 4 inches to 2 feet 8 inches in breadth, $\frac{7}{16}$ to $\frac{8}{16}$ inch in thickness.
For the top	6 feet in length, 1 foot 9 inches to 2 feet 1 inch in breadth, $\frac{5}{8}$ to $\frac{3}{4}$ inch in thickness.
For the sides	6 feet to 6 feet 6 inches in length, 2 feet in breadth, $\frac{1}{2}$ to $\frac{3}{4}$ inch in thickness.

Although these plates have been severally forged with every possible attention, yet, to render them perfectly flat, they are not allowed by Mr. Stephenson to be used for the tubes until each has been passed by the Company's superintendent between two uncompromising massive iron rollers, worked by steam, which, by revolving, quietly remove or rather squeeze down that variety of pimples, boils, lumps, bumps, and humps which from unequal contraction in the process of cooling occasionally disfigure the surface of plate-iron, and which in the workman s dictionary bear the generic name of '*buckles*.' When the plates, the largest of which weigh about 7 cwt., have been thus accurately flattened, they are, one after another, according to their dimensions, carried by two or more men towards one of several immense wrought-iron levers, which, under the influence of steam, but apparently of their own accord, are to be seen from morning till night, whether surrounded by workmen or not, very slowly and very indolently ascending and descending once in every three seconds.

Beneath the short end of this powerful lever there is affixed to *the bottom* of a huge mass of solid iron a steel bolt—about the *length, thickness,* and latent power of Lord John Russell's

thumb—which, endowed with the enormous pressure of from 60 to 80 tons, sinks, at every pulsation of the engine, into a hole rather larger than itself, perforated in a small anvil beneath.

As soon as the labourers of the Department bearing each plate arrive at this powerful machine, the engineer in charge of it, assisted by the carrying-men, dexterously places the edge of the iron upon the anvil in such a position that the little punch in its descent shall consecutively impinge upon one of a series of chalk dots, which, at 4 inches from each other and 1½ inch from the edge, have been previously marked around the four sides of the plate; and thus four rows of rivet-holes averaging an inch in diameter are, by the irresistible power we have described, pierced through plate-iron from one-half to three-fourths of an inch in thickness, quite as easily as a young cook playfully pokes her finger through the dough she is kneading, or as the child Horner perforated the crust of his Christmas pie, when

> 'He put in his thumb,
> And pulled out a plum,
> And said—What a good boy am I!'

Some of the steam-arms or levers just described are gifted with what may be termed 'double-thumbs,' and accordingly these perforate *two* holes at a time, or forty per minute—the round pieces of iron cut out falling, at each pulsation of the engine, upon the ground, through the matrix or perforation in the anvil.

When the plates, averaging from six to twelve feet in length by above two feet in breadth, have been thus punched all round, and before they are brought to the tube, they are framed together on the ground in compartments of about twenty plates each (five in length and four in breadth), in order to be connected to each other by what are termed *covering-plates* and *angle-irons*.

In order to prepare the former (which are half an inch in thickness, one foot in breadth, and about two feet long) they are heated in a small furnace, when, instead of passing between rollers, they are put under a stamping, or as it is technically termed a *joggling* block, which by repeated blows renders their surface perfectly flat; after which a series of holes corresponding

in size as well as in distance from each other with those in the 'plates' are punched all along the outer edge of each of their four sides. When thus prepared, two of these small covering-plates—one on each side—are made to cover and overlap the horizontal line of windage existing between the edges of the plates, which, as we have stated, have been previously arranged so as to touch each other; and bolts being driven through the corresponding holes of the three plates (the large plates lying between the two covering ones), they are firmly riveted together by the process we shall now describe.

RIVETS.

In the construction of the Britannia tubes there have been required no less than two millions of bolts, averaging $\frac{7}{8}$ths of an inch in diameter and 4 inches in length. The quantity of rod-iron consumed for this purpose has therefore amounted in length to 126 miles, and in weight to about 900 tons!

The mode in which these legions of rivets have been constructed is briefly as follows:—

At the western end of the Company's principal forging establishment there stands a furnace or trough, full of pieces of rod-iron from $3\frac{3}{4}$ to $4\frac{1}{4}$ inches in length, packed together as closely as soldiers in a solid square of infantry. As soon as, by the fiery breath of bellows worked by steam, they have been made uniformly red-hot, a little boy, whom they are all obliged to obey, rapidly and without partiality, favour, or affection, picks them out one after another through the furnace-door with a pair of pincers, from which he quietly drops them perpendicularly into eight moulds, each of which being about $\frac{1}{4}$ of an inch shallower than the length of the piece of iron it respectively receives, they of course all equally protrude about that distance above the surface.

In this position they are handed over to a pale sturdy engineman, or executioner, who, with about as much mercy as Procrustes used to evince towards those who slept on his bed, immediately places them upon an anvil, towards which there very slowly descends a huge superincumbent mass of iron pressed downwards by an immense long wrought-iron lever worked by steam.

By this despotic power the red protruding portion of each little rod is by a single crunch inexorably flattened, or 'fraternised;' and thus suddenly converted—*nolens volens*—into a bolt, it is no sooner thrown upon the ground than the mould from which it was ejected is again, by the child in waiting, filled with another raw red-hot recruit, who by a process exactly the reverse of decapitation is shortened, not by the *loss* but by the *acquisition* of a head!

However, after all, just as 'the Marquis of —— is not the Duke of ——,' so is a bolt not a rivet, nor does it become one until, like a bar-shot, it is made double-headed, an important process which has now to be described.

As soon as each 'set' of the half-inch iron plates which form the sides, top, and bottom of the Britannia tubes, have by a travelling crane been lifted—technically termed 'picked up'—into their places, and have been made to touch each other as closely as possible, a moveable stage on wheels is drawn close to the outside of the tube, for the purpose of firmly connecting every set of plates to that which on each side adjoins it. This work is performed by what is termed 'a set of riveters,' composed of two 'Riveters,' one 'Holder-up,' and two Rivet-boys.

As soon as the two first have ascended the scaffolding on the outside of the tube, and when the Holder-up, sitting on a board suspended by ropes from the roof, has exactly opposite to them taken up his position on the inside, one of the boys quickly abstracts from a furnace, conveniently placed for the purpose, a red-hot bolt, which by a circular swing of his pincers he hurls inside the tube towards the other boy, his comrade or playfellow, who, as actively as possible, with a similar instrument snapping it up, not only runs with it towards the Holder-up, but as long as he can reach the rivet-holes inserts it for him therein. As soon as this is effected, the Holder-up presses against it an enormous iron hammer, which forces it outwards until it is stopped by its own head. The red protruding bolt is now mercilessly assailed by the two Riveters, whose sledge-hammers meeting with a sturdy reaction from that of the Holder up, which by a vast leverage or length of handle elastically returns blow for blow, the bolt, in about thirty seconds, becomes double-headed, when one of the Riveters, dropping his hammer, snatches up a steel

mould about nine inches long, called *a swage*, which he continues to hold upon the newly-formed head until his comrade, by repeated blows of his hammer, has *swaged* it into a workmanlike form.

The bolt is thus finally converted into a rivet, which, by contracting as it cools, binds together the plates even more firmly than they had already been almost cemented by the irresistible coercion of three sledge-hammers; indeed they are so powerfully drawn together, that it has been estimated it would require a force of from four to six tons to each rivet to cause the plates to slide over each other.

The bolts for the upper holes of the interior (which, being about 30 feet high, are of course completely out of the Rivet-boy's reach) are dropped by him into a concentric iron ring, which, by a wire and cord passing over a pulley attached to one of the uppermost plates, is rapidly raised, until the Holder-up is enabled by pincers to grasp the fiery iron, which, on being inserted into its hole, he then instantly, as before, presses with his hammer.

By the operations above described, 'a set of riveters' usually drive per day about 230 rivets, of which in each plate there are about 18 per yard, in two rows, averaging only 2½ inches of clear space between each bolt-head. On the large tubes alone there have been employed at once as many as 40 sets of riveters, besides 26 'platers,' or men to adjust the plates, each having from three to four men to assist him; and when this well-regulated system is in full operation it forms altogether not only an extraordinary but an astounding scene.

Along the *outside* of the tube, suspended at different heights, are to be seen in various attitudes 80 Riveters—some evidently watching for the protruding red bolt, others either horizontally swinging their sledge-hammers, or holding the rivet-swage.

In the *inside* of this iron gallery, which is in comparative darkness, the round rivet-holes in the sides as well as in the roofs not only appear like innumerable stars shining in the firmament of heaven, but the light beaming through each forms another as bright a spot either on the ground or on the internal surface of the tube. Amidst these constellations are to be faintly traced, like the figures on a celestial globe, the outlines of the Holders-

up, sitting at different altitudes on their respective stages. Beneath them 40 or 50 Rivet-boys are dimly seen, some horizontally hurling red-hot bolts, others with extended pincers running forwards with them, while fiery bolts, apparently of their own accord, are to be observed vertically ascending to their doom. This Cyclopean dance, which is of course most appropriately set to music by the deafening reverberations of 70 or 80 sledge-hammers, is not altogether without danger; for not only does a '*holder*-UP' from a wrong movement occasionally—like a political Phaëton—all of a sudden tumble *down*, but the rivet-boys, generally unintentionally, but occasionally, it is said, from pure mischief, burn each other more or less severely, in which cases a couple of these little sucking Vulcans, utterly unable, from incessant noise, to quarrel by words, fall to blows, and have even been observed to fight a sort of infernal duel with pincers, each trying to burn his opponent anywhere and everywhere with his red-hot bolt!

But by far the most curious part of the riveting process is to be seen on the flat roof or top of the tube. This immense deck, which we have already stated to be 472 feet in length, is composed of a pavement of plates to be connected together by 18 longitudinal rows of rivets, the heads of which are to be only 2½ inches apart. Beneath this surface, at a depth of only 1 foot 9 inches, there is, to give additional strength, a similar stratum of plates, the space included between both being divided into eight compartments called flues, 21 inches deep by 20 inches broad, exactly resembling those of a common stove. After the horizontal bottoms and upright sides of these eight flues have been firmly connected together by the battering process we have just described, the upper stratum of plates are loosely laid down, and, being thus by the superincumbent weight of the iron covering securely adjusted, their final connexion is effected as follows:—

A tiny rivet-boy—we observed one little mite only ten years of age—in clothes professionally worn into holes at the knees and elbows—crawling heels foremost for a considerable distance into one of these flues as easily as a yellow ferret trots into a rabbit-hole, is slowly followed by his huge lord and master *the holder-up*, who exactly fits the flue, for the plain and excellent reason, that by Mr. Stephenson the flue was purposely predestined to be

exactly big enough to fit *him;* and as, buried alive in this receptacle, he can move but very slowly, he requires some time, advancing head foremost, to reach the point at which he is to commence his work. On arriving there, his first process, lying on his left side, is with his right hand to pass through one of the rivet-holes in the plate above him a little strong hook, to which is attached a short hempen loop, or noose, which, supporting the heavy end of his huge hammer, forms a fulcrum upon which he can easily raise it against the roof, simply by throwing his right thigh and leg over the extremity of the long lever or handle of the instrument.

When similar preparations, by the injection of other little Rivet-boys and other stout Holders-up into several of the other flues, have been made, the signal for commencing operations is given by several red-hot bolts falling, apparently from the clouds, among the Riveters, who, leaning on their sledge-hammers, have been indolently awaiting their arrival. These bolts have been heated on the outside of the tube on the ground immediately beneath, in a portable furnace, from which a gang of lithesome rivet-boys in attendance extract them as fast as they are required, and then walking away with them, without looking upwards, or apparently caring the hundred-thousandth part of the shaving of a farthing where they may fall, or whom they may burn, they very dexterously, by a sudden swing of their pincers, throw them almost perpendicularly about 45 feet, or about 10 feet higher than the top of the tube, upon which, as we have stated, they fall among the assembled riveters as if they had been dropped from the moon.

As soon as these red-hot meteors descend upon the flat roof, another set of rivet-boys eagerly snap them up, and each running with his bolt, not to the spot where it is required, but to one of certain holes in the plate made on purpose for its insertion, he delivers it into the pincers of the little sweep, rivet-boy, or Ascanius, within the flue, who, having been patiently waiting there to receive it, crawls along with it towards his Pius Æneas, the stout recumbent *holder-up*. As soon as he reaches him he inserts for him the small end of the bolt into the hole for which it has been prepared, and through which, in obedience to its fate, it is *no sooner* seen to protrude, than the sledge-hammers of the ex-

pectant riveters, severely jerking at every blow the heavy leg of the poor holder-up, belabour it and '*swage*' it into a rivet.

The red-hot iron—unlike the riveters—cools during the operation we have just described; and even if a by-stander, from being stone-blind, could not *see* the change in its temperature, it could easily be recognized by the difference in the *sound* of the hammers between striking the bolt while it is soft and hot, and when it has gradually become cool and hard. But whatever may be the variety of colours or of noises which accompany the formation of every one of these roof-rivets, it is impossible to witness the operation we have just described without acknowledging, with a deep sigh, how true is the proverb that 'one half the world,' especially the rich half, 'does not know how the other half lives;' indeed, unless we had witnessed the operation, we could scarcely have believed that any set of human beings, or rather of fellow-creatures, could professionally work from morning till night, stuffed horizontally into a flue of such small dimensions,—that they could endure the confinement which only allows them, by changing from one side to another, to throw sometimes the right leg and sometimes the left over the elastic handle of a hammer,—and above all that they could bear the deafening noises created close to and immediately thundering into their very ears!

In attentively watching the operations just described, we observed that at the *sides* of the tube it required generally eighteen blows of the hammer to flatten the end of the bolt, and then twelve blows on the '*swage*' to finish the head of the rivet; whereas, on the *roof*, the former operation was usually effected by only twelve blows, and the latter by eight or nine. At first we conceived that this difference might be caused by a reduction in the sizes of the plates and bolts: but those in the roof proving to be the thickest and longest, we, on a few moments' reflection, ascertained that the reduction of labour in riveting the roof is caused by the sledge-hammers descending upon it by gravity as well as by the main strength of the riveters; whereas, at the *sides*, they are worked by the latter power only.

As the operation cannot of course be carried on when the weather is either windy or wet, the riveters, holders-up, and rivet-boys very properly receive high wages. The first of these classes,

however, strange to say, look *down* upon the holders-*up* as their inferiors, or rather as their menials; and again the holders-up bully the little ragged-elbowed rivet-boys who wait upon *them*; but so it is, not only over the whole surface of the earth, but in the deep blue sea! In the stomach of the shark we find a dolphin, in whose stomach there is found a flying-fish, which, on dissection, has been found to have preyed on a smaller tribe, and so on. We have, therefore, no unkind reflections to cast upon 'riveters,' 'holders-up,' or 'rivet-boys' for frowning upon, bullying, or burning each other.

ANGLE-IRONS.—The plates of the tubes having throughout been scientifically adjusted in the different positions best suited to resist the variety of strains to which, from external or internal causes, they can possibly be subjected, are finally connected together by small ribs, which are firmly riveted to the plates. The quantity of *angle-iron* thus worked through the top, bottom, and sides of all the tubes amounts to no less than sixty-five miles! The sides are, moreover, connected to the top and bottom of each tube by small triangular plates, called *gussets*, which powerfully prevent the bridge from twisting or writhing under the lateral pressure of the wind.

CHAPTER III.

THE FLOATING OF THE TUBE.

THE GATHERING.—On the principle of 'Quæ regio in terris nostri non plena laboris?' we determined, in the family way, to join that respectable crowd of brother and sister reviewers, ill-naturedly called 'gapers and gazers,' who from all parts of the United Kingdom of Great Britain and Ireland, from the Continent of Europe, and even from the United States of America, were, in various degrees of agitation, inquisitively converging upon North Wales, for the purpose of beholding something which, although unanimously declared to be 'quite new,' few appeared very clearly to understand.

All agreed that the wonder they wished to witness was *The Britannia Bridge;* but what was its principle or its form, what it was to do, or what was to be done to it, no person appeared able to explain to anybody. Some nasally 'guessed' it was to be raised; others—*ore rotundo*—positively declared it was to be only floated. One man truly enough affirmed 'it was to go from earth to earth, straight through the air, to avoid the water'—but by which or by how many of these three elements, or by what other powers, the strange transaction was to be effected, deponent, on cross-examination, was utterly unable to detail.

As the railway from Chester—where the principal portion of the travellers had concentrated—has for several miles been constructed along the sands of the Irish Sea, the passengers during that portion of their journey had ample space and opportunity for calm observation or reflection: as soon, however, as the heavily-laden trains reached Rhyl, there was gradually administered to the admirers of the picturesque a strange dose of intense enjoyment, mixed up with about an equal proportion of acute disappointment.

In flying over the valleys and round the hills and mountains of North Wales, there repeatedly glided before their eyes a succession of scenery of a most beautiful description, which, illuminated by the sunshine of heaven, appeared, as they approached

each great impending mountain, to be exquisitely improving; until all of a sudden—just as if the pestilential breath of an evil spirit had blown out the tallow candle of their happiness—nothing in this world was left to occupy their senses but the cold, chilly air of a damp dungeon rushing across their faces, a strong smell of hot rancid grease and sulphur travelling up their noses, and a loud noise of hard iron wheels, rumbling through a sepulchral pitch-dark tunnel, in their ears.

Hundreds of most excellent people of both sexes, who had been anxiously expecting to see

> 'The rock—whose haughty brow
> Frowns o'er old Conway's foaming flood,'

were grievously chagrined and most piteously disappointed by being told—as, like a pea going through a boy's pea-shooter, they were unintellectually flying through a long dark tube—that they were at that very moment passing it, Straits, Castle, and all. However, the balance of the account current was, on the whole, greatly in their favour, and thus in due time, and in high good humour, all reached Bangor in safety.

It need hardly be said that, early in the morning of the day, or rather of the evening, on which the important operations at the Britannia Bridge were actually carried into effect, every boat that could be engaged, every bus, carriage, waggon, gig, cart, and hack-horse that could be hired in Bangor, Beaumaris, as well as in the neighbouring towns and villages, were in requisition to convey, by repeated trips, the curious to the object of their curiosity,—and certainly on reaching it the picture exhibited was one not very easy to be described.

The first amusing moral that irresistibly forced itself upon us, as our conductor with outstretched whip was endeavouring almost in vain to drive through the crowd, was, that of the many thousands of human beings who at considerable trouble and expense had assembled, more than nine-tenths were evidently wholly and solely absorbed in subjects which, though highly interesting, were alien to the purpose for which they had congregated!

Numbers of persons with heated faces, standing around small tables, allocated in various directions, were intently occupied in quaffing off a beautiful unanalysed pink effervescing mixture, called by its proprietor '*ginger beer*'

The dejected countenance of Punch's English half-starved dog, as, dead tired of the gallows scene, he sat exalted on his tiny platform, was strangely contrasted with the innumerable sets of strong grinning Welsh teeth and bright eyes, that in joyous amphitheatre were concentrated upon him. In several spots the attention of stooping groups of 'ladies and gentlemen' horizontally looking over each other's backs, was solely engrossed in watching—what no one passing could possibly perceive—some trick of rude legerdemain upon the ground. On a small eminence the eyes of hundreds, as they stood jammed together, were elevated towards a jaded white-cheeked harlequin, and a very plump, painted-faced young lady in spangled trousers and low evening frock, who, on the elevated stage on which they stood, jumped, kicked with both legs, and then whirled violently on one, until the rustic clown, thoroughly satisfied with the sample, and unable to resist the alluring cymbals and brass trumpet that accompanied it, slowly ascended the ladder, surrendered his penny, and then, with his back turned towards the crowd, descended into a canvas chamber to wait, or rather on a rough wooden bench, to sit, like Patience on a monument smiling at Hope.

Long rectangular booths, open at three sides, appeared filled with people, in great coats and in petticoats, seated around a table, all seriously occupied in silent mastication. In the moving crowd some were evidently searching for the party they had lost, while others, suddenly stopping, greeted friends they had not expected to meet.

Among the motley costumes displayed, by far the most striking was that of the Welshwomen, many of whom were dressed in beautiful gowns protected by frock coats,—their neatly-plaited white caps, surmounted by large black hats, such as are worn elsewhere by men, giving to their faces, especially to the old, around whose eyes the crows'-feet of caution were to be seen deeply indented, an amusing appearance of doubtful gender, which—it occurred to us at the time—the pencil of HB, with its usual wit, might, in illustration of the Epicene policy of the day, very faithfully transcribe. But whatever were the costumes, the ages, condition, or rank of the immense crowd of both sexes through which our old-fashioned vehicle slowly passed, everything that occurred seemed to elicit merriment,

happiness, and joy. It was, in fact, a general holiday for all; and as boys out of school make it a rule never to think of their master, so apparently with one consent had the vast assemblage around us good-humouredly agreed together to cast aside the book they had intended to read—to forget the lesson they had purposely come to study.

By the kind attention of one of the Company's servants we were conducted in a small boat half way across the rapid currents of the Menai Straits to the little Rock, then completely beneath the water—upon which, under the able direction of Mr. Frank Forster, engineer of the line from Bangor to Holyhead, there had been erected (on a base imbedded in pure Roman cement of 62 feet by 52 feet) the Britannia Tower, which, still surrounded by its scaffolding, majestically arose out of the middle of the stream to a height of 230 feet.

This enormous structure, which weighs upwards of 20,000 tons, and which, from being roughly quarried or hewn, displays on the outside the picturesque appearance of natural rock, is a conglomeration of 148,625 cubic feet of Anglesey marble for the exterior—144,625 cubic feet of sandstone for the interior—and 387 tons of cast-iron beams and girders worked in, to give strength, solidity, and security to the mass. The only way of ascending was by a series of ladders, communicating, one above another, with the successive layers of horizontal balks, of which this immense pile of well-arranged scaffolding was composed—and accordingly, hand over hand and step by step, we leisurely arose until we reached a small platform 15 feet above the pinnacle of the tower.

The view was magnificent. On the east and west were to be seen glittering in large masses the Irish Sea and St. George's Channel, connected together by the narrow Straits, whose silvery course, meandering in the chasm beneath, was alike ornamented and impeded by several very small rocks and islands, round and about which the imprisoned stream evidently struggled with great violence. Upon two or three of these little islands was to be seen, like a white speck, the humble cottage of the fisherman, who alone inhabited it. About a mile towards the Irish Sea there gracefully hung across the stream, in a festoon, which, in the annals of science, will ever encircle the name of Telford,

his celebrated Suspension Bridge, over which a couple of horses, appearing like mice, were trotting.

On the north lay extended a verdant country, surmounted in the direction of the new railroad by the great Anglesey Column, erected by the surrounding inhabitants to the noble Commander of the Cavalry at Waterloo. About two hundred yards beneath this splendid testimonial, and adjoining to a little isolated church, there modestly peeped up a very small free-stone obelisk, erected by the workmen of the tower on which we stood as an humble but affecting tribute of regard to some half-dozen of their comrades, who—poor fellows!—had been killed in the construction of the Britannia Bridge.

On the south the horizon appeared bounded, or rather fortified, by that range of mountains, about forty miles in length, which bear the name of Snowdon, and among which, the loftiest, stands the well-known Patriarch of the group. Between the base of these hills and the Straits was the little wooden city built for the artificers and workmen, its blue slates and whitewashed walls strongly contrasting with each other. In this vicinity we observed, in large masses and patches, the moving multitude through which we had just driven, and who, unsatiated with enjoyment, were still swarming round one object after another, like bees occasionally dispersing only to meet again.

Lastly, close to the shore, on their wooden platform, from which the crowd, by order of Captain Moorsom, R.N., was very properly strictly excluded, there stood, slightly separated from each other, the sole objects of our journey—namely, the two sets of hollow tubes, four in number, which, under the sole superintendence of Mr. Edwin Clark, had been constructed as the aërial passages for the up and down trains across the Straits. Being each 472 feet in length, and being also of the height of an ordinary two-storied dwelling, they all together appeared like a street or row of chimneyless houses half a mile long, built on the water's edge; indeed, if windows and doors had been painted upon them, the resemblance would have been perfect. Of the four lengthy compartments, the two on the eastern extremity, and that on the western end, had been painted red; the remaining one, which in a few hours was not only to be launched but floated down the stream to the very foot of the tower on which we stood, had been finished in stone-colour.

We would willingly conclude our slight panoramic picture by describing the appearance of the moving water gliding past the foot of the tower far beneath; but on going to the edge of the masonry to look down at it, we must confess that we found it to be utterly impracticable to gaze even for a moment at the dizzy scene.

In descending from the eminence we had been enjoying, we paused at 50 feet from the top to inspect the steam-engine and boiler therein inserted for working two hydraulic presses, which principally reposed upon a wall 10 feet 6 inches thick, the other three walls being 7 feet 6 inches in thickness. At 107 feet from the top, and at 103 feet from the water, we again stopped for a few minutes to enter the immense passage in the Britannia Tower, through which—strange to think—trains full of up and down passengers at railway speed are to pass and repass each other. The ends of the tubes from the Anglesey and Carnarvon Towers, reposing far away on the beach, meeting at this point on immense cast-iron plates interposed on the masonry to secure an equal pressure, are not only to be firmly connected together, but by their weight are substantially riveted to the fabric. To the opposite ends of these tubes, the extremities of those passing from the embankment to the two land towers just named are also in like manner to be firmly connected; by which means each aërial gallery will eventually be composed of a single hollow iron beam 1511 feet in length, far surpassing in size any piece of wrought-iron work ever before put together—its weight, 5000 tons, being nearly equal to that of two 120-gun ships, having on board, ready for sea, guns, powder, shot, provisions, crew, flags, captains, chaplains, admiral, and all!

Lastly, to bring the component parts of this not only extended but attenuated mass of iron into vigorous action, or, in other words, to enable it to exert its utmost possible strength, Mr. Stephenson has directed that after the component parts of each of the two parallel tubes have, by the process already described, been firmly riveted into one continuous hollow beam, the extremities thereof shall be lowered about 15 inches, by taking away the false keels or foundations, on which in their construction they had purposely been raised. By this simple operation it is estimated that the tube will receive a strength of 30 per cent. in addition to that which it possessed in separate lengths, and without the precise amount of tension so scientifically de-

vised. When thus finally completed, the total length of the bridge will amount to 1833 feet 4 inches.

To enable this enormous mass of thin plate-iron—(the middle of which, as we have stated, is to rest heavily on to that passage through the Britannia Tower to which we have descended)—comfortably to expand itself and contract according to the temperature of the weather—a yawning enjoyment which requires the space of about 12 inches—a number of cast-iron rollers, as well as of balls of gun metal, all six inches in diameter, have been placed on immense cast-iron frames deposited on the land towers and abutments—so that the tubes, like the tide beneath them, may freely flow forwards or ebb backwards at their free will and pleasure, or rather according to the immutable laws of the Omnipotent Power by which they have been created.

On crawling upon our hands and knees through a gap or hole in the masonry of the Britannia Tower, which had been kept open for the purpose of passing through it a stout hawser for hauling to its destination the floating tube, we suddenly perceived at its base lying prostrate immediately beneath us—on a large platform latticed like the grating of a ship, and under which the deep stream was rushing with fearful violence, boiling, bubbling, eddying around, as well as dimpling along the piles that obstructed it—what at the first glance very much resembled the main-sail of a man-of-war stretched out to dry—but which we soon discovered to be a conglomeration of the earth-stained fustian jackets, fustian trowsers, dusty stockings, hob-nailed shoes, red sun-burnt faces and brown horny fingers of a confused mass of over-tired labourers, all dead asleep under the stiff extended bars of the capstan which they had constructed, and at which they had been working.

Although they were lying, what in country parlance is termed 'top and tail,' jammed together so closely that in no place could we have managed to step between them, not a single eye was open, or scarcely a mouth shut. The expression of their honest countenances, as well as of their collapsed frames, plainly told not only how completely they had been exhausted, but how sweet was the rest they were enjoying. In the right hands of several of them, old stumpy pipes of different lengths, also exhausted, were apparently just dropping from their fingers, and while the hot sun

was roasting their faces and bare throats, a number of very ordinary blue-bottle flies in search of some game or other were either running down their noses and along their lips to the corners of their mouths, or busily hunting across the stubble of their beards.

Although for some time 'we paced along the giddy footing of the hatches' on which they were snoring, gazing sometimes at them, sometimes at the wild scenery around them, and sometimes at the active element that was rushing beneath, no one of the mass awakened or even moved, and thus, poor fellows! they knew not, and never will know, the pleasure we enjoyed in reviewing them!

On rowing from Britannia rock we had, of course, a full view of the remainder of the masonry, containing altogether no less than 1,500,000 cubic feet of stone, of which this stupendous work is composed. As, however, it would be tedious to enter into its details, we will merely, while our boat is approaching the shore, state, that the towers and abutments are externally composed of the grey roughly-hewn Anglesey marble we have described; that the land-towers, the bases of which are the same as that of the Britannia, are each 198 feet above high-water, and that they contain 210 tons of cast-iron girders and beams.

The four colossal statues of lions—we must not compare them to sentinels, for they are couchant—which in pairs terminate the land ends of the abutments that on each side of the straits laterally support its approaching embankment—are composed of the same marble as the towers. These noble animals, which are of the antique, knocker-nosed, pimple-faced Egyptian, instead of the real Numidian form, although sitting, are each 12 feet high, 25 feet long, and weigh 30 tons. Their appearance is grand, grave, and imposing—the position they occupy being 180 feet in advance of the entrances into the two tubes, which so closely resemble that over the drawbridge into a fortress, that one looks up almost involuntarily for the portcullis.

The net-work of scaffolding, nearly 100 feet high, upon which the short tubes communicating from the Anglesey abutments to the land-tower had been permanently constructed, not only appeared highly picturesque, but was very cleverly composed of large solid balks of timber from 12 to 16 inches square, and from 40 to 60 feet in length.

THE FLOATING OF THE TUBE.

On landing we, of course, proceeded to the long range of tubes, or streets, we have described.

The arrangements which Mr. Stephenson had devised for floating the first of them to its destination were briefly as follows:—

As soon as this portion of the gallery was finally completed, the props upon which it had rested at a height above the wooden platform sufficient to enable artificers to work beneath it, were removed, so as to allow it to be supported only at its two extremities. The result of this trial satisfactorily demonstrated the accuracy of the calculations upon which the tube had been purposely constructed circular at bottom to the height or camber of nine inches, in order that when it assumed its proper bearing it should become perfectly straight—*which it did.*

During its formation a portion of the wooden platform under each of its ends was cut away and the rock beneath excavated, until on either side there was formed a dock just large enough to admit four pontoons, each 98 feet long, 25 feet wide, and 11 feet deep. When these docks were completed the eight pontoons,—scuttled at the bottom by valves which could either let in or keep out the water at pleasure,—were deposited at their posts; and though their combined power of floatage amounted to 3200 tons, the weight of the tube with its apparatus being only 1800 tons, yet, in consequence of the valves being kept open so as to allow the tide to flow in and out, they lay on their bottoms like foundered vessels; and thus it was curious to see crouching, as it were, in ambush beneath the tube a dormant power, only waiting for the word of command, *up and at 'em*, to execute the duty they were competent to perform.

Besides these arrangements, Mr. Stephenson, in pursuance of a plan which had been deliberately committed to paper, had ordered the construction, on the Anglesey and on the Carnarvon shores, as also on stages constructed on piles at the Britannia rock, of a series of capstans, communicating with the pontoons by a set of ropes and hawsers more than two miles in length. Of these the principal were two four-inch hawsers, or leading-strings, between which, like a captive wild elephant between two

tame ones, the tube was to be safely guarded, guided, and conducted from its cradle to its position at the feet of the Anglesey and Britannia towers.

These preparations having been all completed, and every man having been appointed to his post, the valves in the eight pontoons were closed, in consequence of which they simultaneously rose with the tide, until their gunwales, like the shoulders of Atlas, gradually received their load.

At this moment the few who had been admitted to the spot watched with intense anxiety the extremities of the tubes, which, from the severe pressure they had been inflicting, had, in a slight degree, forced their way into the wooden balks that supported them. By degrees this pressure was observed perceptibly to relax, until a slight crack, and then a crevice, was seen to exist between the old points of contact. In a few seconds this crevice was converted into daylight, amidst a general whisper of exultation announcing, 'IT'S AFLOAT!' The tube, however, was still firmly retained in its dock by two conflicting powers—namely, one set of hawsers, maternally holding it to the quiet home on which it had been constructed—and another set from the shore diametrically opposite, hauling it outwards to its destiny.

At this moment we ascended, by a long ladder, to the top of the tube, and had scarcely reached it when Mr. Stephenson very quietly gave the important word of command—*Cut the land attachments!* Some carpenters, all ready with their axes, at a few strokes nearly severed the strands, and, the tension from the opposite hawsers bursting the remainder, the long street, upon whose flat roof we stood, slowly, silently, and majestically moved into the water.

As the two extremities of the floating tube had been in allignment with those of the tubes on each side, which of course remained stationary, and whose roofs were loaded with well-dressed spectators, its advance was as clearly defined as that of a single regiment when, leaving its division to stand at ease, it marches by word of command from the centre out in front of its comrades.

Upon the deck or roof of the tube, which we may observe had no guard or railing, there was nailed Mr. Stephenson's plan, exhibiting the eight positions or minuet attitudes which the floating monster was to assume at different periods of its voyage;

and, as it had 100 feet to proceed before its first change, we had leisure to gaze upon the strange interesting scene that surrounded us.

From the lofty summit of the Britannia Tower, surmounted by the Union Jack, to those of the Anglesey and Carnarvon Towers on either side of it, were suspended, in two immense festoons, flags of all colours and of all nations. Every vessel at anchor, every steamer under weigh, as well as several houses on shore, were similarly ornamented. At different points on each coast, and especially upon every eminence, were congregated large variegated masses of human beings. The great green woods of Carnarvon seemed literally swarming alive with them, and, to add to the audience, a large steamer—arriving almost too late—as it scuffled to a safe position, exhibited a dense mass of black hats and showy bonnets, enlivened by a brass band, which was not unappropriately playing 'Rule *Britannia*,' the breeze wafting along with it the manly, joyous song of the sailors who, at the capstans on the opposite shore, were cheerily hauling in the hawsers upon which, for the moment, the thread of our destinies depended.

On arriving at Position No. 2, it became necessary to exchange the mechanical power by which the tube had been forced forwards, for that of the tide, which was to carry it end foremost down the stream to its goal. As, however, this latter power—to say nothing of a strong breeze of wind which drove the same way—would have propelled the lengthy mass more than twice as fast as it had been declared prudent it should proceed, a very strong power, by means of a small capstan, was exerted in each set of pontoons, to compress between wooden concentric clamps the guide-hawsers, by which contrivance the pace was regulated with the greatest possible precision. This most important duty was confided to, and executed by, two volunteer assistants, Mr. Brunel and Mr. Locke (we rank them alphabetically); and although the whole scene of the flotation was one of the most interesting it has ever been our chequered fortune to witness, there was no part of it on which we gazed, and have since reflected, with such unmixed pleasure, as the zeal and almost over-anxiety with which Mr. Stephenson's two competitors in fame stood, during the whole operation, intently

watching him, until by either mutely raising his arms horizontally upwards, or in like manner slowly depressing them, he should communicate to them his desire that the speed might be increased or diminished.

But besides regulating the speed, it was repeatedly necessary, especially at the points we have enumerated, slightly to alter the position of the tube by means of capstans, often working together with combined powers on different points of the shores. Orders to this effect were silently communicated by exhibiting from the top of the tube large wooden letters, and by the waving of flags of different colours, in consequence of which the men of the distant capstans belonging to the letters telegraphically shown, were, at the same moment, seen violently to run round, as if they had suddenly been electrified. Indeed at one point the poor fellows were all at once thrown upon their backs, in consequence of the rupture of the capstan-stop.

The duties of Captain Claxton—whose scientific and nautical acquirements had previously been evinced by floating the Great Britain at Dundrum—were highly important. Besides the experienced opinions he had contributed, he had sole command of the whole of the marine force, and accordingly from the top of the tube he continually communicated through his trumpet his orders to various small boats which, as floating aide-de-camps, attended upon him.

As he was getting ashore in the morning, we happened to see one of his crew, by suddenly pulling in the bow-oar, strike him so severely on the forehead that the blood instantly burst forth, as if to see who 'so unkindly knocked.' In half-a-dozen seconds, however, his pocket-handkerchief was tied over it, and he was giving his orders if possible more eagerly than before.

'*Jack!*' said a sailor from another boat, as with a quid in his cheek he slowly walked up to the coxswain, '*what's the matter with the Cappen's head?*'

'*A hoar struck him,*' replied the sailor to his brother 'blue-jacket,' who at once appeared to be perfectly satisfied, as if he professionally knew that it was in the nature of an oar to do so.

When the tube was at about the middle of its transit, a slight embarrassment occurred which for a few minutes excited, we afterwards were informed, considerable alarm among the spec-

tators on shore. In one of the most important of our changes of position, a strong hawser, connecting the tube with one of the capstans on the Carnarvon beach, came against the prow of a fishing-boat purposely anchored in the middle of the stream by a chain, which so resolutely resisted the immense pressure inflicted upon it, that the hawser was bent into an angle of about 100 degrees. The coxswain of a gig manned by four hands, seeing this, gallantly rowed up to the boat at anchor, jumped on board, and then, with more zeal than science, standing on the wrong side of the hawser, immediately put a handspike under it to heave it up. *That man will be killed*—said Mr. Stephenson very quietly. Captain Claxton vociferously assailed him through his trumpet, but the crew were Welsh; could not understand English; and accordingly the man, as if he had been applauded, exerting himself in all attitudes, made every possible exertion not only to kill himself but his comrades astern, who most certainly would also have been nearly severed by the hawser had it been liberated; but a tiny bump or ornament of iron on the boat's head providentially made it impossible, and the hawser having been veered out from ashore, the tube instantly righted.

The seventh movement brought the foremost end of the tube about 12 feet past the Anglesey Tower, and the rear end being now close to its destination, the hook of an immense crab or pulley-block passing through a hole purposely left in the masonry of the Britannia Tower was no sooner affixed to it than the workmen at the capstan on piles, whom we described as asleep, instantly ran round, until the tube was by main strength dragged —like the head of a bullock in the shambles—to a ring from which it could not possibly retreat. By a combination of capstan-power on the north shore, the foremost or opposite end was now drawn backwards until it came to the edge of the Anglesey Tower; and although we were aware that the measurements had of course been accurately predetermined, yet it was really a beautiful triumph of Science to behold the immense tube pass into its place by a windage or clear space amounting, as nearly as we could judge it, to *rather less than three quarters of an inch.*

The tube having now evidently at both ends attained its position over the stone ledge in the excavation that had been purposely constructed for it, a deafening—and, to us, a deeply-

affecting—cheer suddenly and simultaneously burst out into a continuous roar of applause from the multitudes congregated in all directions, whose attention had been so riveted to the series of operations they had been witnessing, that not a sound had previously escaped from them; nor had they, in any place, been seen to move from the spots at which they either stood or sat.

Mr. Stephenson took no notice whatever of this salute; indeed we much question if he even heard it, for his attention was intently occupied in giving to his able and confidential assistant, Mr. Wild, directions respecting the final adjustment of the temporary fastenings by which the tube was to be retained; but the crowd of spectators—like that at a theatre when the curtain of the after-piece drops—were already seen hurrying away in all directions, by steam, by boats, by carriages, and on foot, until, in the brief course of an hour, both coasts were clear. The tide, however, during the operations we have described had become high, had turned, and was now beginning to be violent; the valves therefore having been partially drawn up, the pontoons, as they gradually filled, sank, until the widely-separated ends of the tube slowly descended to their respective shelf or ledge on each tower; and the discarded power that had successfully transported the vast gallery across the water then floating away with the stream—gently transferred from one element to another—it was thus left in the aëriform position it had been planned to occupy!

During the operations we have detailed there were, of course, made by the spectators of both sexes a variety of observations of more or less wisdom, of which our limits will only allow us historically to record a single sample.

'*Dear me!*' said an old gentleman, as the tube when it first swung across the Straits was in perspective seen approaching the platform on which he sat, and which was immediately in front of the awful chasm between Britannia and Anglesey Towers, '*they have surely been and made it too* SHORT; *they must put a bit* ON!' As soon, however, as, veering round, it approached him broadside foremost, he whispered, '*I'm quite sure it's too* LONG; *they'll have to cut a piece* OFF!'

A lady said to her companion, '*Mr. Stephenson appeared*

dreadfully excited during the passage! Didn't you observe how he kept continually stretching out his arms, raising them up and then sinking them down in this way? (suiting her words to the actions by which the speed of the voyage had calmly been regulated). *But no wonder he was so agitated!'*

The Company's servants were engaged until long after sunset in securing and placing in safety the various materials, &c., that had been in requisition during the day, and it was not till past midnight that, over-tired, they managed one after another to retire to rest.

On the following morning, after we had bidden adieu to the hospitable inmates of a small wooden habitation beneath the Anglesey Tower, in which we had been very kindly received, we had occasion to pass near to a stand which had purposely been constructed in a peculiarly advantageous position, to enable the Directors of the Chester and Holyhead Railway to witness the operation. Upon the centre bench of this platform,—the ground far around which was partially covered with bits of orange-peel, greasy papers that had contained sandwiches, and other scraps, indicative of an intellectual feast that was over,—we observed, reclining entirely by himself, a person in the easy garb of a gentleman, who appeared to be in the exquisite enjoyment of a cigar, whose white smoke in long expirations was periodically exuding from his lips, as with unaverted eyes he sat indolently gazing at the aërial gallery before him. It was the father looking at his new-born child! He had strolled down from Llanfairpvllgwyngyll, where, undisturbed by consonants, he had soundly slept, to behold in sunshine and in solitude that which during a weary period of gestation had been either mysteriously moving in his brain, or like a vision—sometimes of good omen and sometimes of bad—had by night as well as by day occasionally been flitting across his mind.

Without, however, presuming to divine, from the rising fumes of a cigar, the various subjects of *his* ruminations, we will merely confess that, on looking up from our boat, as it glided away, at the aërial gallery he was contemplating, *we* were astonished to find ourselves very much in the frail predicament of mind of the old gentleman of yesterday whose emotions we so accurately delineated—for when the tube was lying on the Carnarvon shore

we certainly fancied that it looked too heavy and too high for its object, whereas it now appeared almost too light and too low: in short, it had assumed the simple appearance which, in principle, it had been designed to bear—that of a rectangular hollow beam; and although it had in fact annulled the awful chasm between the Anglesey and Britannia Towers, nevertheless, by exactly measuring it, it now appeared considerably to have increased it!

Moreover, in viewing this low narrow passage—only 15 feet by 30—which, without cuneiform support, was stretching half across the Menai Straits—(it has been quaintly observed by Mr. Latimer Clark, in his clever pamphlet, that if this single joint of the tube could be placed on its tiny end in St. Paul's Churchyard, it would reach 107 feet higher than the cross)—it seemed surprising to us that by any arrangement of materials it could possibly be made strong enough to support even itself, much less heavily-laden trains of passengers and goods flying through it, and actually passing each other in the air, at railway speed. And the more we called reason and reflection to our assistance, the more incomprehensible did the mystery practically appear; for the plate-iron of which this aërial gallery is composed is literally *not so thick* as the lid, sides, and bottom which, by heartless contract, are *required* for an elm coffin 6½ feet long, 2½ feet wide, and 2 feet deep, of strength merely sufficient to carry the corpse of an emaciated, friendless pauper from the workhouse to his grave!

The covering of this iron passage, 1841 feet in length, is literally not thicker than the hide of the elephant! Lastly, it is scarcely thicker than the bark of the 'good old English' oak; and if this noble sovereign, notwithstanding the 'heart' and interior substance of which it boasts, is, even in the well-protected park in which it has been born and bred, often prostrated by the storm, how difficult is it to conceive that an attenuated aërial hollow beam, no thicker than its mere rind, should by human science be constituted strong enough to withstand, besides the weights rushing through it, the natural gales and artificial squalls of wind to which, throughout its immense length, and at its fearful height, it is permanently to be exposed!

CHAPTER IV.

RAISING THE TUBES.

HYDRAULIC PRESS.—Although the tube, resting at each end upon the ledge or shelf that had been prepared for it, had been deposited high enough to allow an ordinary boat to row under it, yet the heaviest job still remained—that of raising it about 100 feet to its final resting-place. This operation, which might be compared to lifting the Burlington Arcade to the top of St. James's Church—supposing always that the said church arose out of very deep, rapid water—was, as we have already stated, to be performed by the slow but irresistible agency of hydraulic power; and as one of the presses used is said not only to be the largest in the world, but the most powerful machine that has ever been constructed, we will venture to offer to those of our readers who may never have reflected upon the subject, a brief, homely explanation of the simple hydrostatic principle upon which that most astonishing engine, the hydraulic press, invented, or rather rendered practicable by Bramah, is constructed.

If the whole of the fresh water behind the lock-gates of a canal communicating directly with, say the German Ocean, were to be suddenly withdrawn, it is evident that the sea-side of the gates would receive water-pressure, and the other side none.

Now if a second set of gates were to be inserted in the salt-water at a short distance, say one foot, in front of the old ones—(the water between both sets of gates remaining at the same sea-level as before)—many, and perhaps most people, would believe that the pressure of the German Ocean against the new gates would of course relieve, if not entirely remove, the pressure against the old ones,—just as a barrier before the entrance of a theatre most certainly relieves those between it and the door from the pressure of the mob without.

This opinion, however, is fallacious; for, supposing that the new gates were by machinery to be firmly closed, the foot of salt-

water included between them and the old gates would not only continue to press exactly as heavily against the latter as the whole German Ocean had previously done, but by simultaneously inflicting the same amount of pressure against the inside of the new gates as the ocean was inflicting on their outside, the pressure of this imprisoned single foot of water would so accurately counterpoise that of the whole wide, free ocean, that if the machinery which had closed the new gates were suddenly to be removed, they (the new gates) would be found, as it were, vertically to float between the two equal pressures!

But, anomalous as this theory may appear, it is beautifully demonstrated by the well-known fact, that if water be poured into a glass syphon, of which one leg is, say an inch in diameter, and the other, say a foot, the smaller quantity will exactly counterbalance the greater, and the water will consequently, in both legs, rise precisely to the same level; and this would be the case if one leg of the syphon were as large as the German Ocean, and the other as small as the distance between the two sets of lock-gates we have just described—indeed it is evident that, if a hole were to be bored through the bottom of the new gates, a syphon would instantly be formed, of which the ocean would be one leg and the foot of included salt-water the other.

Now Bramah, on reflection, clearly perceived that from this simple principle in nature a most important mechanical power might be obtained; for if, say five ounces of water in a small tube, can be made to counterbalance, say a hundred thousand ounces of water in a large one, it is evident that, by the mere substitution in the bottom of the larger tube of a flat solid substance instead of the water, a pressure upon the body so inserted of very nearly a hundred thousand ounces would be inflicted by the application of only five ounces!—and, as this pressure would of course be proportionately increased by increasing the height, or in other words the *weight* of water in the smaller tube—Bramah therefore further reasoned that if, instead of adding to the quantity of water in the smaller tube, the fluid therein were to be ejected downwards by a force-pump, the pressure upwards in the larger tube would proportionately be most enormously increased; and *à fortiori*, as, in lieu of the old-fashioned forcing-pump, the power of steam has lately been exerted, our readers will, we

believe, at once perceive that, if the instrument which holds the water could but be made strong enough, the pressure which might be inflicted within it by a few gallons of water might almost be illimitable.

The *principle* of the hydraulic press having been above faintly explained, the power and dimensions of the extraordinary engine of this nature, which has been constructed by Messrs. Easton and Amos, of Southwark, for raising the Britannia tubes, may be thus briefly described.

The cylinder, or large tube, of the syphon, which is 9 feet 4 inches in length, 4 feet 10 inches in diameter, and which is made of cast-iron 11 inches thick, weighs 16 tons. The piston, termed *the Ram*, which, pressed upwards by the water, works within it, is 20 inches in diameter. The whole machine complete weighs upwards of 40 tons. The force-pump barrel communicates with a slender tube or passage about the size of a lady's smallest finger, which, like the touch-hole of a cannon, is drilled through the metallic side of the cylinder; and thus, although the syphonic principle really exists, nothing appears to the eye but a sturdy cast-iron cylinder of about the length of a 24 lb. cannon, having the thickness of metal of a 13-inch mortar.

From the above trifling data it will be evident that, leaving friction and the weight of the ram out of the question, the lifting power of this machine must exceed the force applied to the force-pump in the same proportion that $1\frac{1}{4}$ inch-diameter bears to a diameter of 20 inches—which in figures amounts to about 354 to 1; and as the two 40-horse steam-engines which are to be applied to the touch-hole for compressing the water in the smaller tube would, it has been calculated by Mr. Latimer Clark, be sufficient to force the fluid more than five times as high as the top of Snowdon, or 5000 feet higher than the summit of Mount Blanc, our readers have only to increase the force in this proportion to become sensible of the extraordinary power which the hydraulic press of the Britannia Bridge is capable of exerting for the purpose of raising its tubes. In short, the power is to the weight of the tubes as follows:—

	Tons.
Weight of one of the largest tubes . . .	1800
Lifting-power of the hydraulic press . . .	2622

The mode in which this enormous power is practically exercised is as follows :—

The hydraulic cylinder, standing erect, like a cannon on its breech, on two stout wrought-iron beams bolted to each other, is, together with its steam boiler, securely fixed in the upper region of the Britannia Tower, 148 feet above the level of its base, and about 45 feet above that to which the bridge is to be raised.

Around the neck of the iron ram or piston, which protrudes 8 inches above the top of this cylinder, there is affixed a strong horizontal iron beam 13 feet in length, resembling the wooden yoke used by milkmaids for carrying their pails, from the extremities of which there hang two enormous iron chains, composed of eight or nine flat links or plates, each 7 inches broad, 1 inch thick, and 6 feet in length, firmly bolted together. These chains (which, in order to lift the tube to its destination, are required to be each 145 feet long) weigh no less than 100 tons—which is more than double the weight of the equestrian statue of the Duke of Wellington, lately erected in Hyde Park—commonly regarded as one of the heaviest lifts ever effected: and certainly, when from the giddy region of the Britannia Tower, in which this hydraulic machinery, like the nest of an eagle, has been deposited, the stranger, after looking down upon the enormous weight of iron not only to be supported but to be raised, compares the whole mass with the diameter of the little touch-hole immediately before him, through which the lifting-power has to pass—and when he reflects that the whole process can, with the greatest ease, be regulated and controlled by a single man, it is impossible to help feeling deeply grateful to the Divine Power for an invention which, at first sight, has more the appearance of magic than of art.

As soon as all adjustments were prepared, and the boiler was sufficiently heated, the great piston, under the influence of severe pressure upon the water beneath it, began slowly, like a school-boy's 'jack-in-the-box,' to emerge from the cylinder, and, apparently regardless of the enormous weight that oppressed his shoulders, he continued steadily to rise, until in about thirty minutes he lifted the tube six feet, and, as he could raise it no *higher, the huge* chains beneath were immediately secured by a *powerful vice* or 'clams' at the foot of the press. By letting

off the water, which of course relieved the pressure beneath the piston, it descended, by its own gravity, to the point from which it had started, where the chains being again affixed to its yoke—an operation which requires about half an hour—it again, by the vitality of steam, lifted its weight another six feet; and as the other end of the tube was simultaneously treated in a similar way, the whole was progressively raised nearly thirty feet, when, by the bursting of the largest of the hydraulic presses—a contingency which, from the faithless crystalline character of *cast* iron, it is utterly impossible for Science to prevent—the ponderous mass unexpectedly fell through a space of seven inches—an awful *phenomenon* to witness—until it was gradually stopped by the packing, timber, and brickwork which had cautiously been underbuilt during its ascent—and from which it has since been raised to a point a few feet above its ultimate position, where two strong iron beams being placed beneath, it was triumphantly lowered to its final resting-place, to be the aërial highway of the public!

CHAPTER V.

MR. FAIRBAIRN'S CLAIMS.

DURING the brief inspection which we made of the Britannia Bridge we can truly say, that, far from feeling a desire to award to Mr. Robert Stephenson the whole merit of the wonderful piece of mechanism before us, we repeatedly paused not only to reflect but to regret how little the Public would probably ever think of, or care for, the assistant-engineers, overseers, skilled artificers, and honest steady labourers, by whose zeal, assiduity, and personal courage the heavy job had practically been completed. 'Who,' we asked ourselves, 'will ever care to thank those who, surrounded by the torrent, toiled by night as well as by day at the foundation of the Britannia Tower? When that beautiful structure of scaffolding, composed of 570,000 cubic feet of timber, upon which the land-tubes have been constructed, shall be removed, who will ever expend a thought of kindly recollection on those by whose skill it was devised, or by whose enduring patience it was at no trivial risk constructed? What reward, beyond their bare wages, will the superintendents of the various departments of the work ever receive for the anxiety they suffered for several years, under a weight of responsibility which, while it promised for success no rewards, threatened for failure the severest description of moral punishment?' And, lastly, we said to ourselves, as on the top of the tube we stood over the holders-up and rivet-boys, who, stuffed together into flues in the painful attitudes we have described, were working immediately beneath our feet, 'Who, in flying across the Menai Straits, will ever feel that he is indebted for his life to the care and attention with which these poor fellows are patiently riveting, one after another, the millions of bolts by which he is to be safely transported in his aërial transit?'

Impressed with the justice of these feelings, we were therefore not only strongly predisposed to award to every person, however

humble, who had been connected with this great work, the full amount of credit due to him for the particular portion of it which he individually executed, but we were ready almost to admire, and at all events to excuse, that *esprit de corps* which invariably induces every separate department to consider its labours to have been of the greatest importance; indeed, there is no better qualification in a subordinate than to be what is commonly called 'proud of his work.' If, therefore, Mr. Fairbairn, Mr. Hodgkinson, and Mr. Clark had, either collectively or individually, endeavoured to assume a larger share of merit than was intrinsically due to the important preliminary investigations they had conducted, we should indulgently have smiled at their boyish zeal, and even if we could not have approved, we should most certainly have refrained from noticing it; but in the serious appeal, or rather demand, which Mr. Fairbairn has deemed it advisable to make to the public, he has not only claimed merit which is the property of his colleagues, but has, although he occasionally renounces it, claimed for himself that of the invention itself! He has therefore forced us, as indeed every one who takes a mechanical interest in the subject, dispassionately to weigh the value of the claims he has urged, and at all events to hear the cause in which he voluntarily appears as the plaintiff.

The investigation ought to be an easy one, and so indeed it is; nevertheless we regret to say, that Mr. Fairbairn with very great ingenuity has riveted together facts, documents, and assertions which, when logically separated and compared with the evidence taken before the House of Commons, confuse, confound, and condemn each other.

We will endeavour by very brief extracts to arrange the case as fairly as possible. Mr. Fairbairn in his book states—

'That Mr. Stephenson conceived the original idea of a huge tubular bridge to be constructed of riveted plates and *supported by chains*.'—p. 2.

'He [Mr. S.] never for a moment entertained the idea of making the tube self-supporting. The wrought-iron tube, according to his idea, was, indeed, entirely subservient to the chains.'—p. 3.

'The form which the Menai Bridge now has, was advocated by me alone.'—p. 31.

'I was anxious to clear the tube of the incumbrance of chains, which it must be borne in mind were intended from the first, not only for the support of the tubes, but for the purpose of carrying them forward from the platform on which they were to be built across their respective spans to their final positions on the piers.'—p. 48.

'Mr. Stephenson was present at one or two of the experiments afterwards made on the model-tube, and, after witnessing them, his fears were in a great degree removed; he *then* determined to abandon the use of auxiliary chains, and from that time, October, 1846, to the completion of the Conway Bridge, he relied with confidence on the strength of the tube itself, and attached a proper degree of importance to the results of *my* earlier experiments.'—p. 50.

The above-quoted assertions are all dated by Mr. Fairbairn '1849;' and as in the last of them he distinctly points out that it was in October, 1846, that Mr. Stephenson abandoned the use of auxiliary chains 'for the form which the Menai Bridge now has,' which beamlike form Mr. Fairbairn positively asserts '*was advocated by him alone*,' it becomes necessary that we should refer to the following minutes of evidence which on the 5th and 6th of May, 1845, was given before the Committee of the House of Commons 'on Chester and Holyhead Railway Bill, Group 2, Thomas Henry Sutton Sotheron, Esq., in the Chair.'

'ROBERT STEPHENSON, ESQ., *called; examined by* MR. ROBINSON.

'You are the engineer of the intended line of railway?—I am.

'Is there to be a bridge of 104 feet high and with the arches of 450 feet span?—There is.

'Do you consider that a practicable and safe mode of crossing the Menai under the circumstances?—Yes, I do.

'Is it not an arch on the plan of the Southwark Bridge?—No. Perhaps I may at once explain to the Committee the idea I have adopted. I conceive a tube. Supposing a wrought-iron tube to extend across the Straits, and that tube to have, we will say, 25 feet diameter to hold a line of railway, and the line of railway would run inside of it. In addition to that we should have to erect a chain platform *for the purpose of the building*. Then the question would arise whether the chains would be allowed to remain, or whether they would be taken away down. My own opinion is, *that a tube of wrought-iron would possess sufficient strength and rigidity to support a railway-train.*

'Is this mode of construction quite original?—It is.

'It is your own view?—Yes, meeting the contingencies which have been put upon me by Government engineers.

'How would you place it in the position you mean it to occupy?—There will be a platform erected and suspended by the chains, just the same as they bind an iron vessel.

'I wish to ask you whether this is your own suggestion?—It is entirely.

'From the experiments you have made, and from the inquiries you have also made, are you satisfied that that suggestion of yours is a practicable and safe one?—I am not only satisfied that it is practicable, but I must confess that I cannot see my way at present to adopting anything else.

'And in what way do you propose to unite the plates?—In the same way as the iron that is used in a ship is united.

'It will be one mass of iron?—Yes, a smooth tube made of wrought-iron the same as a ship.

'A succession of plates united together?—Yes, with rivets.

'No rods?—No rods.

'Running the whole length?—No; there may be what is termed angle irons.

'What would be the diameter of each of these tubes?—I should make them elliptical, 25 feet in height, and just wide enough to hold one line of railway trains.

'What would be the distance below without support?—450 feet.

'In each of them?—Yes.

'You have not made up your mind as to the safety of dispensing with the chains?—No, I have not.

'It would be impossible to do so until it is constructed, would it not?—I would rather leave that, because I would make the design so that the chains might either be taken away or left, and during the construction we should have ample opportunity of ascertaining whether we could safely take away the chains or not.

'There would be no great advantage from taking away the chains?—No, only it would make it more costly if they remained: they would be applicable to other purposes, and they would cost from 30,000*l.* to 40,000*l.*

'You have no doubt, Mr. Stephenson, that the principle applied to this great span will give ample security to the public?—Oh! I am quite sure of it.

'And you said that although you thought that an iron tube of the thickness you have mentioned, viz. ¾ of an inch above and below, and a little less on the two sides, *will bear any weight that is likely to be put upon it* in the shape of trains?—Yes.

'You feel perfectly confident upon that point?—Yes, I feel perfectly confident; but with a view to remove any doubts upon that point, I feel it necessary to make a series of experiments, not that it will convince me more than I am at present, but that it shall convey confidence to the Board of Directors under whom I am acting.'

It has since been stated in a memorandum written by Mr. Stephenson,

'that the Committee before whom he was examined, alarmed at his project, were inclined to hesitate about passing the bill; that their apprehensions were mainly appeased by General Pasley saying that the chains were not necessarily to be removed; and that, as the bill would evidently have been lost had he (Mr. Stephenson) insisted on removing them, he modified his opinion as above quoted.'

Our readers will now observe whether or not such a necessity really existed.

'General PASLEY was called in and examined by the Committee.

. . . . . .

'On the whole, therefore, General Pasley, you think a bridge built on the plan proposed by Mr. Stephenson would give ample security for trains passing there?—I feel convinced it would.

'And you believe it to be a practicable plan?—Quite so.

'But you do not advise the removal of the chains?—I do not: I see no advantage in it.

'Do you think there would be any hazard in removing them?—I think it would be better to leave them.

'It is difficult to answer the question until the bridge is actually built, is it not?—Yes.

'Previously to a railway being opened, it is usual to send you to ascertain the security of the railway, is it not?—Yes.

'And therefore you probably will be sent down to ascertain the security of this bridge before the railway is open to the public?—Yes.

'And could these chains be removed without the sanction of the Government?—I do not know. I do not see any objection to their being there. *I should recommend their not being removed.*'

Without offering any opinion on the foregoing allegations and evidence, we will at once proceed to the causes of Mr. Fairbairn's retirement from the service of the Chester and *Holyhead* Railway Company, and of his publication of the large

costly volume before us. The details had best be explained by himself.

Mr. Fairbairn publishes two letters (a portion of one of them in italics) from Mr. Stephenson, of which the following are extracts:

1. '23rd August, 1847.—I was surprised at your letter this morning, asking me if I wished you to take charge of the floating and lifting. *I consider you as acting with me in every department of the proceedings.*'

2. '7th February, 1848.—My dear Sir,—I only reached London this morning from Newcastle, when I received your previous note, upon which I will speak to you verbally. You allow your feelings to get the better of you respecting Mr. Hodgkinson, and I think improperly; for it is clear that his experiments alone have given the true law that governs the strength of different sized tubes. Both your plan and my own for calculating the strength are empirical; but Hodgkinson's experiments and his deductions from them give the true law with remarkable consistency.

'Yours faithfully, ROBERT STEPHENSON.'

'But,' says Mr. Fairbairn, 'what chiefly led me to this decision [his retirement] was the position assumed by Mr. Stephenson: his public misrepresentation of the position I held under the Company, and his endeavour to recognise my services as the labours of an *assistant* under his control, and acting entirely under his direction. Had Mr. Stephenson in his public address done me the justice to state my independent claim to some of the most important principles observed in the construction of the tubes, I might perhaps have continued my services until the final completion of the whole undertaking, and most assuredly this work [Mr. F.'s book] would never have come before the public. —p. 171.

'Upon the completion,' continues Mr. Fairbairn, 'of the first Conway tube, it was resolved by the gentlemen and inhabitants of the neighbourhood to entertain Mr. Stephenson at a public dinner, which should at the same time celebrate the satisfactory conclusion of this great engineering triumph.'—p. 172. . . . . 'In the course of his address at the Conway entertainment Mr. Stephenson is reported to have made the following observations:—" I believe it will be expected of me—indeed I should feel it improper if I were to omit on this occasion detailing very succinctly a few facts with reference to the rise and progress of the idea which led to the construction of tubular bridges; because in doing so it will not only afford me an opportunity of explaining to you precisely what the origin was, but it will also give me

the opportunity of expressing my obligations to those who have so largely aided me in bringing about the result which we are met to commemorate." '—p. 174.

The following are the '*observations*' of which Mr. Fairbairn complains:

'As soon as the bill was obtained, and it became time to commence, I obtained the consent of the Directors to institute a very laborious and elaborate and expensive series of experiments, in order more thoroughly to test experimentally the theory I had formed, and also to add suggestions for its full development. It was then that I called in the aid of two gentlemen, eminent both of them in their profession—Mr. Fairbairn and Mr. Hodgkinson. They had both distinguished themselves for elaborate series of experiments on cast-iron bridges; and although this was a different material, still from their accomplishments and skill they were well qualified to aid me in my research. They heartily went into it; and the result is what you now see under the walls of your venerable old castle. But having mentioned these two names, there is another gentleman that I wish to call to your notice—a gentleman to whose talents, to whose zeal and ability from the commencement of this undertaking, I am much indebted; and indeed the full development of the principle of tubular bridges is by no means in a small degree indebted to him—I allude to my assistant, Mr. Edwin Clark. He has been my closet companion from the commencement of the preliminary investigation. No variation or inconsistency in the experiments eluded his keen perception: he was always on the look-out for contingencies that might affect the success—though not the principle, still the success—of the undertaking; and he and the other gentlemen whom I have just named are the three to whom I feel deeply indebted for having brought the theory I first broached to such perfection; and I thus publicly tender them my acknowledgments.'—p. 176.

Two days after this speech Mr. Fairbairn communicated to Mr. Stephenson his resignation, the reasons for which he explains in his book as follows:—

'Mr. Stephenson [in his speech at the Conway dinner] states that he called in the aid of Mr. Hodgkinson and myself at the same time. Now it is essential to the proof of my claims that this assertion should be explicitly contradicted. It was I, and not Mr. Stephenson, that solicited Mr. Hodgkinson's co-operation, and this was not done until I had been actively engaged for several months in my experimental researches, and after I had discovered the principle of strength which

was offered in the cellular top, and not only proved the impracticability of Mr. Stephenson's original conception, but had given the outline of that form of tube which was ultimately carried into execution.

'When Mr. Stephenson had made up his mind to claim in the manner he did the whole merit of the undertaking, it is not difficult to understand his reason for giving Mr. Clark—his own assistant—so prominent a position.'—p. 177.

As it is perfectly immaterial to us what feelings Mr. Fairbairn may entertain or express as respects his colleagues, Mr. Hodgkinson and Mr. Clark, we have no observations to offer on that point; but as it appears from the foregoing extracts that Mr. Fairbairn complains of Mr. Stephenson having 'endeavoured to recognise his services as the labours of an assistant under his control,' it is necessary to state, or, if Mr. Fairbairn prefers it, unequivocally to admit, that Mr. Stephenson—having engaged Mr. Fairbairn to make a series of experiments for the purpose of determining the best form of tube and the law of its resistance to fracture—having on the 13th of May, 1846, further recommended to the Board that Mr. Fairbairn should be engaged 'to superintend with him the construction and erection of the Conway and Britannia Bridges'—and having still further recommended that a salary of 1250*l.* per annum, which Mr. Fairbairn enjoyed for more than two years, should be granted to him: all of which appointments and recommendations the Board of Directors 'at Mr. Stephenson's recommendation sanctioned and ordered'—certainly *did* consider Mr. Fairbairn as an 'assistant under his control.' The Directors of the Company, rightly or wrongly, entertained the very same opinion; and as Mr. Fairbairn in his Letter of Resignation above referred to had styled himself '*engineer along with yourself* for the tubular bridges,' the Board deemed it proper to direct that, in reply to that letter, the following very significant minute should be transmitted through their engineer-in-chief to his *in*subordinate:—

'Copy. *June* 7, 1848. Read—Letter from Mr. Fairbairn, dated 22nd May, tendering his resignation of the appointment of *assistant* to Mr. Stephenson in the construction of the tubular bridges. Resolved—That Mr. Fairbairn's letter be referred to Mr. Stephenson with a request that *he* accept the proffered resignation of Mr. Fairbairn; and that, inasmuch as the appointment was originally made by *him* (Mr. Stephenson), he do so in such terms as he may think proper.'

All this seems strong—but strange as well as strong to add—Mr. Fairbairn, in the preface of his own book, himself acknowledges 'the honour which he felt in having been selected *by Mr. Stephenson* as the fittest person to elucidate the subject and conduct the inquiry.' Moreover, in addition to 'the *honour*,' Mr. Fairbairn enjoyed the exquisite *advantage* of supplying from his boiler-manufactory at Millwall all the iron which, between his meals, he luxuriously crushed, broke, and bruised in experiments, the whole of which cost the Company no less than 6000*l.*; besides which it appears from the Board's minutes that Mr. Fairbairn obtained a most lucrative contract for the construction of the ironwork of the bridges; which contract, to the great displeasure of the Directors, he immediately sold at a profit of several thousand pounds to Mr. Mare of Blackwall; in short, Mr. Fairbairn, like every eminent tradesman, naturally enough worked for money, and not for fame; and if the Company had proposed to have paid him in the latter coin, he would, no doubt, have very laconically corrected their mistake. Leaving therefore Mr. Stephenson completely out of the case, may not Mr. Fairbairn be fairly asked whether he conceives that the credit of the investigation he was engaged to make legitimately belongs to the Board of Directors, who paid for the experiments, or to the individual who was paid for conducting them?

If Mr. Fairbairn, after having expended 10,000*l.* in searching for coals or in boring for water, had in either or in both cases been successful, would he have claimed the merit of the result for himself, or would he have given it to the honest foreman, who, at wages of three guineas a week, had been engaged by him to conduct the expensive investigation he had proposed?

Mr. Fairbairn's third and last complaint is, that Mr. Stephenson has withheld from him the sole credit of the final adoption of rectangular tubes, with rectangular flues in the tops and bottoms thereof. Now Mr. Hodgkinson very stanchly maintains that it was *he* who first recommended rectangular tubes. It however appears, from the following extracts from Mr. Fairbairn's own statements, and written reports to Mr. Stephenson, as published in his book, that these discoveries, instead of belonging to any one of the triumvirate, were the natural sequences

of the investigation recommended by Mr. Stephenson and sanctioned and paid for by the Board of Directors.

'The peculiar nature,' says Mr. Fairbairn, 'of the investigation, and the almost total absence of data for the successful prosecution of the inquiry, operated in a great degree to retard its progress. The transverse strength of an iron tube composed of riveted plates *was an entirely new subject* (p. 209). . . . Weakness was found where strength was expected, and hence repeated changes of form as well as changes in the distribution of the material became absolutely necessary (p. 210). . . . We have not as yet arrived at the strongest form of tube; we are nevertheless *approaching that desideratum* (p. 15). . . . Some curious and interesting phenomena presented themselves in these experiments. Many of them are *anomalous* to our preconceived notions of the strength of materials, and *totally different* from every theory yet exhibited in any previous research (p. 39). . . . Although suspension chains may be useful in the construction in the first instance, they would nevertheless be highly improper to depend upon as the principal support of the bridge (p. 41). . . . The difficulties experienced in retaining the cylindrical tubes in shape, when submitted to severe strains, *naturally suggested the rectangular form.* Many new modes of this kind were prepared and experimented upon (p. 9). . . . *These experiments led to the trial of the rectangular form of tube* with a corrugated top, the superior strength of which decided me to adopt that cellular structure of the top of the tube *which ultimately merged* into a single row of rectangular cells.'—p. 12.

(Which Mr. Hodgkinson, as before stated, declares was the result of *his* previous calculations.)

Again, Mr. Fairbairn, on the 3rd of April, 1846, in reporting to Mr. Stephenson, states:—'It has already *been determined by experiment* that the strongest section yet obtained is that of the rectangular form;' and this being one of the important '*quæsita*' which Mr. Stephenson by the investigation he confided to Mr. Fairbairn and his colleagues had been desirous to obtain, it was by *his* recommendation approved of by the Board of Directors and finally adopted.

Having now concluded our extracts from Mr. Fairbairn's book, on the merits of which we have, for his sake, examined scarcely any other witness than himself, it only remains to be observed that annexed to the volume there are a series of costly plates curiously indicative of the text. Mr. Fairbairn states—

'It will, I think, be generally allowed that it was very natural I should desire to have my name *publicly* (Ital. *sic*) associated with Mr. Stephenson's as Joint Engineer for these Bridges.'—p. 170.

And accordingly in his plates Mr. Fairbairn has offered to the public a beautiful

PERSPECTIVE VIEW OF A PORTION OF THE BRITANNIA BRIDGE
'RESTING ON THE CENTRE OF THE MENAI STRAIT.
'ROBERT STEPHENSON AND WILLIAM FAIRBAIRN, ENGINEERS.'

Now the facts of the case, or rather of the picture, are briefly as follows:—

1. The masonry of the lofty tower, so faithfully represented, was erected under the *sole* superintendence of Mr. Frank Forster, C.E.

2. The tube, not so correctly represented,—inasmuch as, from the date of Mr. Fairbairn's retirement, nearly two years must elapse before it can attain the position it occupies in the picture,—has almost entirely been constructed under the sole superintendence of Mr. Edwin Clark, C.E.

3. Mr. Fairbairn did not for a single day work at the construction of the tower, or, excepting a few occasional visits, at that of the tube.

'SIC TRANSIT GLORIA MUNDI.'

CHAPTER VI.

MORAL.

THE sums expended by the Chester and Holyhead Railway Company to the 30th June last have been as follows:—

	£.	s.	d.
Cost of Tubular Bridge for crossing the Conway .	110,000	0	0
Ditto ditto ditto Menai Straits	500,000	0	0
Remainder of the line, &c.	2,971,587	0	0
Total expenditure . . .	3,581,587	0	0
Contribution to be paid towards the construction of the Holyhead Harbour of Refuge . .	200,000	0	0
Present market-value of original stock .	72 per cent. discount.		
Ditto of preferential stock at 5½ per cent. interest, issued by the Company to obtain funds to complete the works . . .	20 per cent. discount.		

The above figures strikingly illustrate the consequences of the system, or rather want of system, which the Imperial Parliament has hitherto pursued in railway legislation.

If the communication between England and Ireland *viâ* Holyhead, had—on the principle which at the time we earnestly recommended—been considered as one great arterial line, the proportionate expense of contributing to a harbour of refuge, as well as the enormous cost of raising the two bridges necessary for crossing the Conway and Menai Straits to a height sufficient for the distinctly different purposes of railway traffic and the sailing of large vessels, might, with some appearance of justice, have been thrown upon the aforesaid large Company;—although in the day of M'Adam roads, Telford's bridges over the very same places, and the construction of harbours, were considered as *national* works, and were accordingly executed at the cost of the public. Very improvidently, however, the moderately re-

munerating portions of the line were *first* established by Parliament;—and thus the little Company which, with feeble means was to continue from Chester the circulation of the Royal mail —of goods of all descriptions—of first, second, and third class passengers—and of Her Majesty's troops and artillery between London and Dublin, was saddled not only with its own natural burden, but with the preternatural works we have described; indeed, in order to obtain its Act of Parliament, it was so completely at the mercy of the Government, that it was obliged to submit to certain excruciating terms which—with the non-payment to the Company of its 30,000*l.* a-year for the mail-service, which the members of the late Administration well know was insured to it—and with a competition between the Government and the Company's steamers most lamentably inflicting a serious loss upon both parties—have, it appears, reduced the value of its shares in the market by more than 70 per cent., and, of course, completely drained its capital of all dividend. '*And*,' it has been said, '*so much the better for the public!*' Be it so! we have no desire to relieve the proprietors of the Chester and Holyhead Railway from the terms (whatever they may be) of their contract. On the other hand, there can be no doubt that, if Parliament holds every Railway Company hard and fast to its bargain when it has made a bad one, it ought not, at all events, by *ex post facto* legislation, to let loose the public from every imprudent engagement which they, on their parts, have contracted to perform. We will exemplify our meaning by a particular case.

At the fag-end of last session Lord Monteagle introduced into the House of Lords a bill, which, though hastily approved by a vote of that House, was very properly, as we think, discountenanced by Lord John Russell, and finally thrown out in the House of Commons, to deprive railway proprietors of the power they now enjoy of solely auditing their own accounts.

It was not attempted to be shown that an auditor appointed by the public could increase the number of trains—improve station accommodation—or give additional security or even comfort to any description of persons travelling by rail. It was not attempted to be shown that the proposed measure would confer a single additional privilege upon railway *share-owners*. On the

contrary, it was frankly admitted that '*to* THEM *the books of the Company are by law at all times open;*' but as a highly popular doctrine, it was honestly and unscrupulously explained that the real object of the proposed audit-bill was to enable *the public*, by legislative 'clairvoyance,' accurately to ascertain the present and prospective state of every Railway Company, in order that the proprietors thereof might be prevented from any longer selling their shares to the aforesaid 'public' at prices above their intrinsic value.

If Parliament were to force every horse-dealer to divulge the vices and infirmities of the sorry animal he is at this moment 'chaunting,' there can be no doubt that the public, by a general illumination, would have vast reason to rejoice. If Parliament were to oblige the proprietors of all quack medicines to pre-publish the exact cost of the ingredients which compose them, there can be no doubt that John Bull might henceforward repeatedly swallow a peck of pills for less money than he is now paying for 'a single ounce box.' In fact, for aught that we in our sequestered hermitage know, it may be very possible, that if every merchant's ledger were, to-morrow morning, by legislative enactment, to be declared public property, the prices of sugar, tea, iron, hides, coals, and a hundred other articles in the market, would, in the course of a few hours, be lowered. It has, however, hitherto been considered that the British merchant's counting-house is as much 'his castle' as his residence; that his accounts are as sacred as his person; and that, morally speaking, nothing but a suspension of the *Habeas Corpus* Act can authorise the seizure of either the one or the other.

When Mr. Stephenson's magnificent project of a cast-iron bridge of two arches, 100 feet high at the crown,—which, instead of costing 600,000*l.* (being at the rate of 1000*l.* per yard), could have been executed for 250,000*l.*,—was rejected by the Admiralty, that powerful Board very justifiably declined to advise by what other means the stipulations they required should or even *could* be effected. The doubts, the difficulties, the risks, and the uncertainties were all, with an official shrug, very prudently thrown upon the little Company; and if the *expenses* of the Chester and Holyhead Railway could thus be legitimately forced into darkness, is it just, after the proprietors have not only performed their

bargain, but have nearly been ruined by doing so, that their *accounts* should, by an *ex post facto* law, be dragged into daylight, not merely to gratify idle disinterested curiosity, but for the open avowed object of shielding the public—or rather public stock-brokers—from the very risk and pecuniary uncertainty which they (the proprietors) were forced to encounter?

But, as in all transactions, 'honesty is the best policy,' so we submit that the proposed interference with the rights of Railway proprietors to be the sole auditors of their own accounts is not only unjust, but impolitic. Thousands of owners of Railway stock have, by a fatal experience, lately learned that it is possible for a joint-stock company, as it is possible for any of the individuals composing it, to encourage profuse expenditure, to act dishonestly, and, for a short time, to veil impending ruin by mystified accounts. The antidote, however, to this poisonous admixture of indolence and fraud is already working its cure. The punishment of the principal transgressor has already become 'greater than he can bear;' and a salutary suspicion has not only spontaneously aroused the proprietors of two hundred millions of Railway property, who had hitherto very culpably neglected their own affairs, but has materially depreciated all Railway stock; and there can be no doubt that this wholesome castigatory depression of their property below its intrinsic value will, *to the evident benefit of the share-purchasing public*, continue to exist, until Railway proprietors have sense enough to perceive that it is their *interest* to remove the suspicion which created it, by the prompt establishment of that open examination, and that honest as well as disinterested audit of their accounts—(in the last half-yearly printed statement of the London and North-Western Railway Company's affairs we observe that there was expended in six months in 'audit and account 2488*l.* 5*s.* 6*d.*')—which will satisfy men of business; and which was, no doubt, Lord Monteagle's object when—with rather more zeal than consideration—he proposed that it should forcibly be effected by Act of Parliament.

The desideratum, however, we feel confident, can be obtained by milder means; and although between buyers and sellers of all descriptions contention must always exist to a certain degree, we trust that the proprietors of the rails which have gridironed the

country, and those who travel on them, instead of unnecessarily snarling over the invention, will feel that it is alike their interest and their duty to join together hand in hand, magnanimously to develop to its utmost possible extent the greatest blessing, or at least one of the very greatest, which has ever been imparted to mankind.

It is generally asserted by railway proprietors, who are of course self-interested in the question, that the existing practice of rating their respective Companies according to their earnings, —their industry,—or, as it is technically termed, their 'profits in trade,' is unjust, because the same system, or fiscal screw, is not equally applied to landowners, manufacturers, or shopkeepers. It is argued that, so long as our old-fashioned highways, besides levying tolls, are allowed to tax for their maintenance every parish through which they pass, it is unreasonable that the same parishes should at the very same moment, by a process diametrically opposite, be allowed to transfer a large proportion of their domestic rates for the support of their poor, &c., upon railways, which, it is affirmed, have, generally speaking, not only grievously overpaid for the land they occupy, but have materially increased the value and prosperity of every city, town, village, hamlet, and field through which or near which they pass.

Upon this serious and important question, involving some general re-adjustment of assessments of every description, we shall abstain from offering any opinion, because we are convinced that sooner or later it will be duly considered by Parliament. In the mean while, however, it is with deep regret we observe that the innumerable direct as well as indirect impositions and taxes which—rightly or wrongly, legally or illegally—have been imposed upon our railways, are already producing the lamentable consequences we ventured to predict. From want of funds, even our greatest railway-companies are openly abandoning branch-lines which they had almost completed; they are reducing the number of their trains; economising at their stations; in fact, in various ways, in proportion not only to the expenses imposed upon them, but moreover to the reductions made in their original Parliamentary tolls, they are—perceptibly as well as imperceptibly —curtailing the convenience and accommodation which, from a

sound regard for their mutual interests, they would most willingly have maintained for the public.

We feel confident that in this unfortunate, short-sighted, narrow-minded conflict, the British Nation is discreditably warring against itself; and having not inattentively watched the practical working of the system, it has been our humble endeavour—by a few pen-and-ink sketches, which we now conclude —to attract the attention of the public to the magnitude of the works of our arterial railways, in order that, from the good sense and good feelings of the community, these new highways may receive that fostering protection and genial support without which the fruits of Science cannot be matured.

POSTSCRIPT.

THE following Letter and extracts are submitted without comment:—

I.—"*To Captain Moorsom, R.N., Chairman of the Board of Directors of the Chester and Holyhead Railway Company.*

"Oxendon, Jan. 3, 1850.

"Sir,—In a pamphlet just published by Mr. T. Fairbairn, it is asserted, with reference to the Britannia Bridge, that 'when Mr. Stephenson, in May, 1845, gave his evidence before a Committee of the House of Commons, he was *totally ignorant* of the principle of construction which has since been adopted.' That at the period alluded to, 'a very vague idea was all he had in his mind,' the vacuum therein having, it is alleged by Mr. Fairbairn, been subsequently filled up by him. That in the construction of the Britannia Bridge, Mr. Robert Stephenson and Mr. Fairbairn were 'most undeniable *colleagues*' (Ital. sic), and not one the *subordinate* (Ital. sic) of the other, and therefore that I have done Mr. Fairbairn very great injustice by having published in my 'High-and-Dry Ways,' that in the preliminary experiments, as well as in the construction of the work in question, he acted, during the period he was employed therein, 'with great zeal and ability as Mr. R. Stephenson's *assistant*.'

"As I feel anxious, in case I have made this alleged mis-statement, not only without delay to correct it, but publicly to offer to Mr. Fairbairn an adequate apology, I beg, if you see no objection, that you will be so good as to explain the precise relative situations of Mr. Robert Stephenson and Mr. Fairbairn, as regards the invention as well as construction of that magnificent work, the Britannia Bridge.

"Drawing your attention to your Board Minute of the 13th of May, 1845, in Mr. Fairbairn's favour,

"I have the honour to be, Sir,

"Your obedient servant,

"F. B. HEAD."

II.—*Reply to the above.*

"Chester and Holyhead Railway,

"Jan. 22, 1850.

"Extract from the Minutes of the Board.

"*Read.*—Letter from Sir F. Head, on the subject of the misunderstanding between Mr. Stephenson and Mr. Fairbairn.

"*Resolved.*—That Sir F. Head be informed,—

"That the date of Mr. Stephenson's intimation to the Directors of his plan of a tubular structure to cross the Menai Straits, in substitution of the arch bridge, is 26th April, 1845.

"That Mr. Fairbairn's appointment was made on the 13th May, 1846.

"That the Directors made the appointment of Mr. Fairbairn at Mr. Stephenson's request, to assist him, but that they looked to Mr. Stephenson as responsible to them.

"ANDREW GIFFORD, *Secretary.*

"*To Sir Francis Head, Bart.*"

III.—*Extract from the printed Inaugural Address of the President,* WILLIAM CUBITT, ESQ., F.R.S., *to the Institution of Civil Engineers, dated January 8th,* 1850.

"After describing 'the boldness of the conception, the scientific simplicity of the design, and the difficulty of the execution' of the tubular bridges across the Conway and Menai Straits, the President apportions the amount of merit due to the several parties engaged therein, as follows:—

"'We must feel justly proud of possessing among us the man whose comprehensive mind could originate this magnificent design, and so scientifically perform a portion of the work as to leave no doubt of its ultimate accomplishment.

"'The world already duly appreciates this great undertaking, and we should not be behindhand in testifying our estimation of the bold conception of Mr. Robert Stephenson in the original idea; his professional skill in the design and execution; his care and caution in availing himself of the talents and experience of Mr. W. Fairbairn and Mr. Eaton Hodgkinson, whose scientific investigations respecting the strength of cast-iron are so well known to the world, and so highly appreciated by our profession; and his entrusting the general construction and elevation to Mr. Frank Forster and Mr. Edwin Clark.

"'Upon the merits of all these gentlemen we may look with pardonable pride and partiality; their labours speak for themselves.'"

THE END.

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ALBEMARLE STREET, LONDON,
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